# cycles

—A MONTHLY REPORT

*June 1951*

FOUNDATION FOR THE STUDY OF CYCLES
*New York, New York*

# CONTENTS

Page

THE DIRECTOR'S LETTER . . . . . . . 201

RESEARCH

The 9.2-Year Cycle in Common Stocks . . . . 204

The 9.18-Month Cycle in the Ton Miles of the Canadian Pacific Railway . . . . . 208

Cycles in the Stock Market - A Preliminary Projection to 1990 219

The 22-Year Cycle in the Advertising Efficiency of the Lydia E. Pinkham Medicine Company . . . 223

The 18 1/3-Year Cycle in Building Construction . . . 225

ANCIENT CYCLES

The Metonic Cycle . . . . . . . 228

The Callippic Cycle . . . . . . . 228

TECHNICAL

Limitations of the Periodogram . . . . . 229

Techniques Involved in the Determination of the 9.2-Year Cycle in Industrial Common Stock Prices . 233

Construction of the Charles H. Pinkham Index of Advertising Efficiency . . . . 234

DATA

Prices 1933 - 1950 in Terms of Gold . . . . . 235

LETTERS . . . . . . . . . 238

THE TIMID SOUL . . . . . . . . 239

The Foundation for the Study of Cycles, Inc., is a non-profit corporation without capital stock, organized in 1940 under the laws of the State of Connecticut. The Foundation is an outgrowth of the permanent committee set up at the First International Conference on Biological Cycles, held at Matamek, Canada, in 1931.

The purposes of the Foundation, as set forth in its charter, are as follows: To foster, promote, carry on, and conduct scientific research and to receive, administer, and disburse funds for scientific, educational, and charitable purposes, all for the public welfare.

As the name implies, the Foundation centers its interests on rhythmic and periodic phenomena, without limitations as to the field of science.

CYCLES — A Monthly Report is published by the Foundation for the Study of Cycles every month except during July and August at the Foundation's offices at 9 East 77th Street, New York 21, N. Y. Subscription rates $10.00 a year. Entered as second class matter at the Post Office at New York, N. Y. Letters for the personal attention of the Director should be sent to East Brady, Pennsylvania

**cycles**

**—a monthly report**

*The Official Bulletin of the Foundation for the Study of Cycles*

VOLUME II NUMBER 6 JUNE 1951

# The Director's Letter

Dear Member:

The other day I received a letter from Mr. John McDowell of Floral Park, New York, which read as follows:

### Mr. McDowell's letter

Dear Mr. Dewey:

In 1948 you made a statement to the New York City Control of the Controllers Institute to the effect that a 54-year cycle showed that 1952 would bring a downward pressure or depression in business, real estate, and building. In view of the Korean situation, would you be kind enough to tell me whether you think this cycle will be fulfilled or will this inflation take the upper hand.

It seems to me that Mr. McDowell's letter brings up a subject of general interest and that you might like to see the letter I wrote him in reply:

### My reply

Dear Mr. McDowell:

I was very glad indeed to get your letter of April 25th.

You are right in remembering that in my talk before the Controllers Institute in New York City I referred to a 54-year cycle. A cycle of about this length has been present in average wholesale prices in this country for as far back as the figures are available. It has been present in wheat prices in Great Britain for about 800 years.

Note that I am talking about prices. I shall speak about real estate and about production later.

The current low of an **ideal** pattern fitted to past behavior of average wholesale prices is, as you have correctly stated, 1952.

Bear in mind that the **actual** low of a cycle almost never comes at the time of **ideal** low. The actual low may come an important fraction of the cycle ahead or after ideal timing, depending upon circumstances.

### A homely example

To give you a homely example familiar in everyday experience, you doubtless know that February 1st is the date of the **ideal** low in temperature in New York City. However, the **actual** low of next winter might easily be two months or 1/6 of the cycle one way or the other from **ideal** timing.

A sixth of 52 is 8-and-a-fraction years and, as economic cycles are usually less regular than the annual temperature cycle, a dozen years one way or the other from ideal timing in any given 54-year low would not be an unreasonable expectation.

### Factors which may distort the ideal cycle

There are many factors which serve to distort the actual behavior. As you have correctly indicated in your letter, the most important of these factors is war.

### War

In the past, major wars have always prevailed over the cycle. That is, it is the war that controls rather than the cycle.

I doubt if the Korean war by itself would be important enough to distort the present cycles significantly, but along with the Korean war we are engaged in a major economic adventure in preparation for World War III, and I would expect these preparations to distort the price cycle importantly as long as they continue.

A second factor that has distorted the present price cycle since 1932 is the fact that in 1933 our government abandoned the gold standard and reverted to a repetition of the greenback era of " funny money" indulged in during and shortly after the Civil War.

The 54-year cycle as it has shown itself in average wholesale prices in this country from Revolutionary War days forward has been in prices in terms of **gold**. To see how the cycle is working out at the present time you must adjust the paper money values to a gold basis. There will be an article on this subject in the June report to members.

A third factor that makes the actual low of a major price cycle come somewhat ahead of or after the ideal timing is the fact that there are a number of other shorter cycles in prices riding on the back of the big cycle. Even if there were no war distortion or no distortion due to the abandonment of the gold standard, these other shorter cycles would doubtless advance or retard the actual low by a number of years.

So much for distorting factors that might make the actual low of average wholesale prices come ahead of or after ideal timing.

### How cycles work

There is one other matter in regard to the effect of cycles that I would like to point out before we leave this matter of the 54-year cycle in average wholesale prices.

Forget all about distortions now and imagine that we are in a cycle which is operating absolutely according to the ideal.

In the past, the 54-year cycle has been associated with changes in the index of prices from levels of about 92 at the crest to levels of about 47 at the trough, or a move of about 45 points on the index in 27 years. This amounts to 1 2/3 points per year. In other words, assuming that the 54-year cycle in prices is still operating, its effect between now and '52 would merely be to cause a 3½ % decrease of the index, measured in gold.

The effect of the 54-year rhythm in prices over a 27-year span is very important indeed, either on the down side or on the up side, but its effect in the last year of the 27 is no greater than its effect during any other one-year period starting with 1925.

To go back to our weather analogy. Assuming a perfectly ideal season for the next twelve months, there is going to be a big difference between summer and winter, but there is going to be very little difference between January 25th and February 1st, or February 1st and February 8th.

Getting away from the concept of a perfectly normal cycle (which never happens) back into the realm of reality, if we assume that the 54-year cycle is still operating—and I think this is a safe assumption—it does not mean that prices next year will be lower than prices this year, any more than it means that this year's prices will be lower than last year's prices. It merely means that because of the effect of this cycle next year's prices will be lower than they otherwise would be.

### Forecast fulfilled

If the other forces are downward, the effect of the 54-year cycle force would be to add to that downward movement and increase it. If other dominating forces are upward, the effect of the 54-year force would be to snub the rise slightly.

In our book CYCLES—The Science of Prediction, written in 1944, Mr. Dakin and I pointed out that the effect of this 54-year cycle might be expected to hold World War II prices (near the trough of the cycle) below World War I prices (near the crest of the cycle). This is exactly what took place. Peak average annual wholesale prices for World War I in gold had an index number of 154.4 (in 1920), 1926 being 100. Maximum World War II prices measured in terms of black market gold in New York City were 72.6 (in 1948).

You will note that I have been speaking all along of average wholesale prices whereas you in your letter spoke also of business, real estate, and building.

### No 54-year cycle yet discovered in real estate or building construction

I do not know of any evidence to suggest that the 54-year cycle is present in real estate activity or in building construction activity. It may of course be there, but if it is, it is certainly relatively unimportant.

### The 54-year cycle in interest rates

Work done by Kondratieff indicates that in France and in England, at all events, the 54-year cycle is present in interest rates, and that the timing of this cycle in interest rates is approximately the same as the timing in prices. If this situation holds true for the United States, there would be a 54-year cycle in interest rates here with its **ideal** low due in 1952.

### The 54-year cycle in production

However, when we come to the matter of physical production, we get into a very different situation.

There is no question but that there are long-term cycles in physical production but I suspect that the timing of the 54-year cycles in production is very different from the timing of this cycle in prices. The only long series of production figures that I have studied seems to show this 54-year rhythm quite importantly for a number of repetitions but in this series of **physical production** the last trough of the ideal cycle came in 1934 and is due for its next crest in 1961.

### Summary

To sum up:

(1) Except for war distortion, one might reasonably expect the 20-year period centering on 1952 to be a period of relatively low prices **in terms of gold.**

(2) However, one would not expect the actual low of prices to come in 1952 at ideal timing regardless of war and even if we were still on a gold basis. The ideal does not often happen in prices any more than in weather.

(3) One can be certain that major wars will introduce distortions that will overwhelm the cycle, at least temporarily.

(4) The 54-year cycle is not present importantly if at all in real estate or in building construction.

(5) The 54-year cycle seems to be present in physical production; but in physical production the timing is very different from the timing in prices, ideal lows coming about 20 years earlier, as best we now know.

I hope this letter has helped to clarify the situation in your mind.

I note with pleasure your interest in the subject of cycles and I am wondering if you might not like to become a member of the Foundation and receive each month (except July and August) a report that we send to our members. Except for a short technical section, this report is written for the layman. It is about 40 pages long and tells you about the latest discoveries in respect to cycles in all different fields. An application blank is enclosed so that if you wish, you can become a member and receive this material regularly.

I look forward to welcoming you in the near future.

Very cordially yours,

Edward R. Dewey

Director

# Research

## THE 9.2-YEAR CYCLE IN COMMON STOCKS

THERE has been a cycle of about 9 years in length in industrial common stock prices from the earliest available figures (1871) to date. As nearly as can be determined at the present time, the length of this cycle is 9.2 years. On the average this cycle shows an overall amplitude of about 42% of trend. This 9-year cycle is the most important single cycle discovered to date in industrial stock market prices.

### Quarterly values in Curve A

Curve A in Fig. 1 on the two pages next following shows prices of industrial common stocks from 1871 through 1950 after adjustment for trend. These are the same values that I charted for you in the April report on pages 148 and 149 except that here I have used quarterly averages instead of monthly values. In addition I have added values from 1854 through 1870 from the Clement-Burgess index (largely railroad stocks), also adjusted for trend. I have reduced the horizontal scale so that I could show you the entire series on one double page spread.

### Smoothed values in Curve B

The distortions caused by the short-term fluctuations can be minimized by smoothing the values shown in Curve A by means of a 3½-year (13 quarter) moving average. I have made these calculations for you and plotted the result as Curve B.

### Timing

On both curves I have drawn in the typical or ideal 9.2-year cycle correct for amplitude, shape, and timing, as nearly as I am able to compute it with only ten cycles with which to work.

Ten 9.2-year waves are clearly apparent. The crests of the ideal waves come in 1854.2 and every 9.2 years thereafter. In other words, in 1863.4, 1872.6, 1881.8, 1891.0, 1900.2, 1909.4, 1918.6, 1927.8, 1937.0 and 1946.2. Future crests of the ideal waves are due in 1955.4, 1964.6, 1973.8, 1983.0 and so on.

Troughs of the ideal waves fall mid-way between crests, namely in 1858.8, 1868.0, 1877.2, 1886.4, 1895.6, 1904.8, 1914.0, 1923.2, 1932.4, and 1941.6. The current trough of the ideal 9.2-year wave is due in 1950.8. Future troughs are due in 1960.0, 1969.2, 1978.4, and so on.

(When timing is indicated by annual figures, for example " 1950, " such a date usually refers to the exact middle of the year. Therefore when timing is indicated by a year and a decimal, the decimal refers to the amount of time past the middle of the year. Thus 1950.5 would be half a year past the middle of 1950, or December 31st of 1950. The time of the ideal 9.2-year low, 1950.8, would therefore be 8/10ths of a year or 9.6 months past June 30th, 1950--in other words, about April 20th, 1951. This convention is awkward, but it is consistent and it is the less of two evils.)

Remember that all these dates refer to the timing of the typical or ideal waves. The actual waves almost always come either ahead of or after perfect timing.

### Shape

As nearly as can be determined, the typical shape of the wave, when the average values are plotted on log paper, is a zigzag of straight lines. Thus, in the 9.2-waves in industrial common stock prices, we have another example of the typical " compound interest " shape which seems to characterize most cycles.

### Strength

As for strength, the typical wave runs from 123.3% of trend at crest to 81.1% of trend at trough, or an overall amplitude of 42.2% of trend. In the move from trough to crest this amounts to an average gain of 9.5% per year.

### Regularity

The regularity of the cycle may be thought of as the extent to which its waves have prevailed over all other cycles and over all accidental factors combined.

The regularity of the 9.2-year cycle from 1854 through 1950 is noteworthy. In the unsmoothed figures adjusted for trend (Curve A) six of the crests (a majority) have come within three-quarters of a year one way or the other of perfect timing. No crest has ever been more than 2¼ years early nor more than 1¼ years late. In the same curve, a majority of the lows have come within half a year one way or the other of perfect timing. No low has ever been more than 2 years early nor more than 2½ years late.

### Wave - by - wave analysis

Let us now look at the chart a little more closely and see how each of the ten waves has unfolded.

In looking at a chart to see the successive cycles, you should run a mental moving average through the figures; that is, you should look for **areas** of high or of low so as to minimize the distorting effects of minor fluctuations. In this particular instance however, a moving average has already been constructed. Therefore, in these comments, I will refer to it (Curve B) instead of to the quarterly average deviations (Curve A).

Waves can be thought of as running either from crest to crest or from trough to trough. As these figures start at a crest and for all practical purposes end at one, let us think of the wave as going from one high point to another.

From this point of view the first wave from 1855 to 1864 unfolded beautifully. The second wave however was largely obliterated. The low was hardly worth speaking of at all, and what low there was came very late. The third wave, from '73 to '82, was a good average wave and so was the fourth wave, even though the crest in 1889 was quite early.

The fifth wave, from 1891 to 1900, was as good as you will ever find them. The sixth wave, from 1900 to 1909, was irregular with two little waves instead of the one big one called for by the ideal pattern. The seventh wave, from 1909 to 1919, shows up nicely in the moving averages even though the actual figures are quite distorted by short-term fluctuations. The eighth wave, ending ideally in 1928, was of course badly distorted in amplitude by the tremendous upsurge which culminated in 1929, but the timing of this wave was not badly distorted and neither was the timing of the ninth wave which followed.

The tenth wave, from 1937 to 1946, the last wave in the series available for study, was also on its part a beautiful wave, as perfect as they ever come. However this fact in itself should put us on notice in regard to possible distortions in the eleventh wave in which we now find ourselves because the past history of this series shows that perfect waves do not often repeat consecutively.

### Significance

As I told you before, there are no purely mathematical tests that seem to me to be entirely satisfactory to determine the significance of a cycle. Until such tests are developed, one is thrown back on the subjective tests of human judgment and common sense. From these criteria, it seems abundantly clear that there has been present in common stock prices from 1854 to date a cycle very close to 9.2 years in length. With ten repetitions of the wave reappearing consecutively over a period of almost 100 years, it would seem that this 9.2-year cycle is real and that it can be expected to continue. It should very definitely be taken into account in any effort to forecast the future of common stock prices.

### Did the 9.2-year low come in 1949?

Assuming all of this to be true, the practical question then arises as to whether or not the current low (ideally due at 1950.8), of the present 9.2-year wave, is going to come early or late. That is, is the low of this present cycle going to be the low which came early in the second quarter of 1949, 2 years ahead of time, or is the actual low of the present cycle still ahead of us?

A low 2 years early is not without past precedent. We had such lows in the fourth quarter of 1884 and in the third quarter of 1921. Twice out of ten instances would indicate one chance in five for such behavior.

### The actuarial approach

Observing the way in which a cycle has behaved in the past may be termed the behavioristic or actuarial approach. This way has its definite advantages—just like the life expectancy tables of a life insurance company. They throw light on the **probability** of this or that—but you and I wish to know more.

### Other cycles MUST be known also

One cannot judge how any given 9.2-year cycle will unfold without taking into account all of the other waves that may be present in the market. I beg of you not to rely upon the 9.2-year wave or try to outguess its irregularities on an actuarial basis until you have done this.

A preliminary and very crude effort to discover at least some of the other more

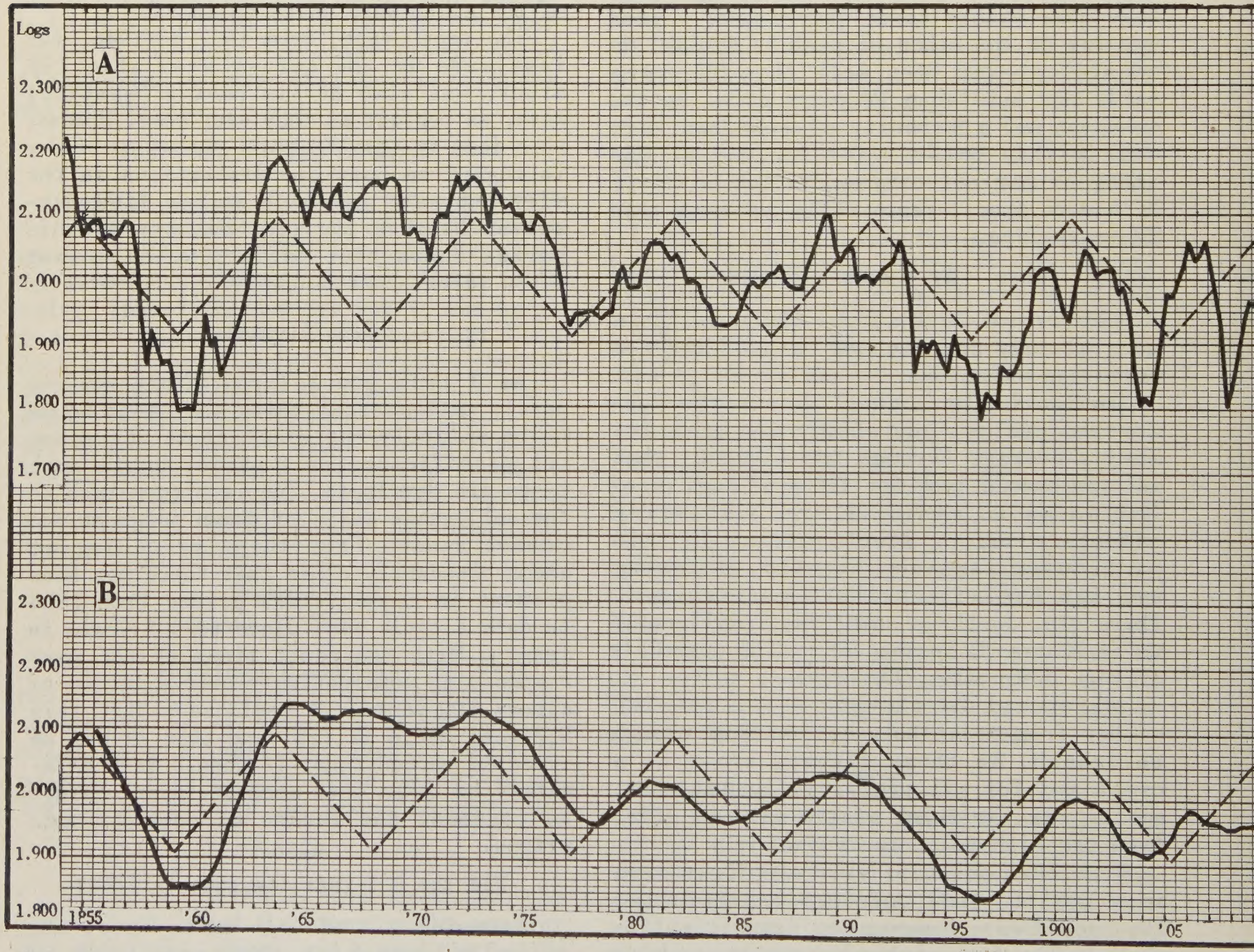


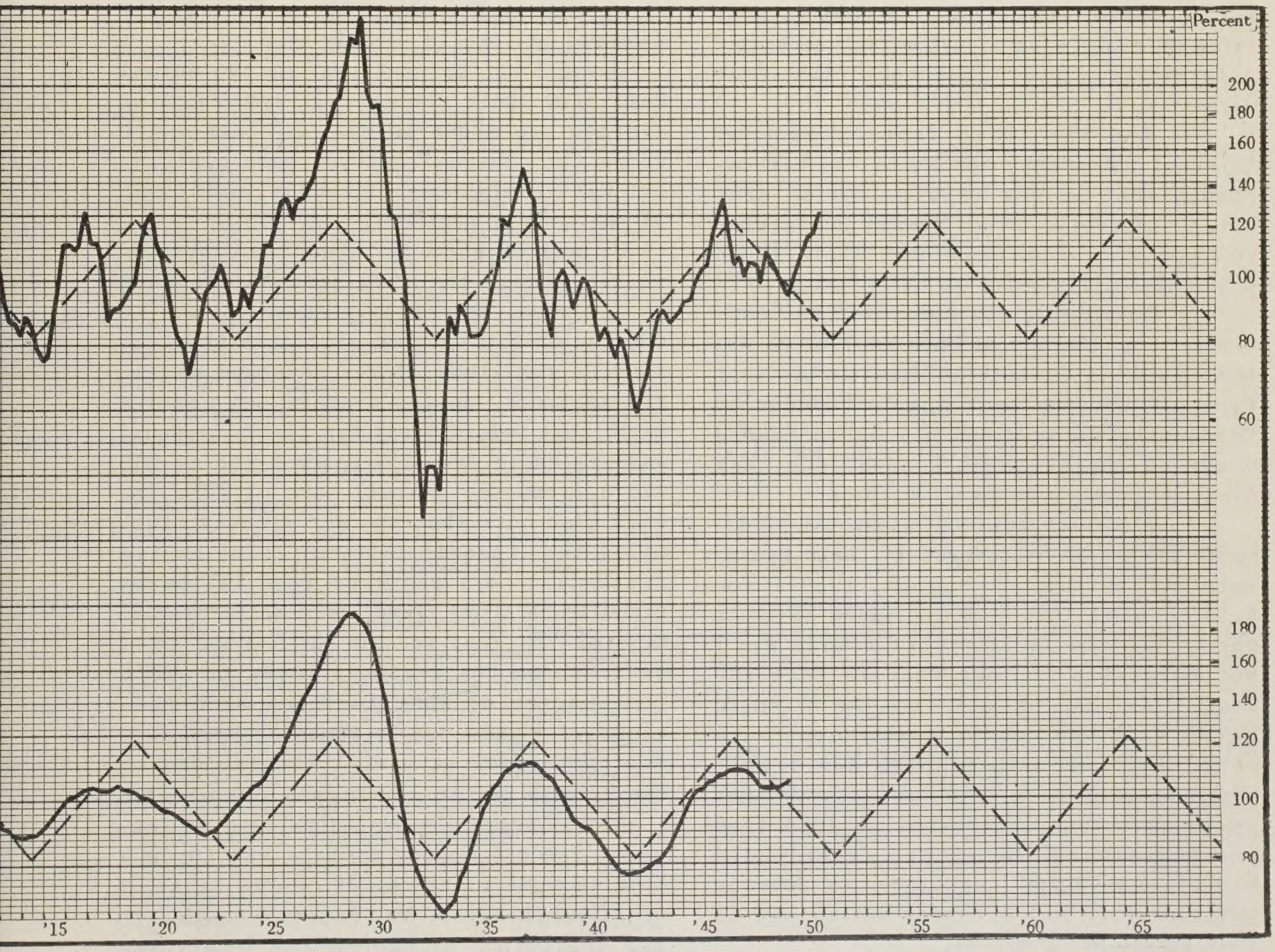
Fig. 1. A. Common Stock Prices, 1854 – 1950, adjusted for trend, together with a regular 9.2-year cycle.
are quarterly averages. Values 1854 – 1870 Clement Burgess Index (chiefly rails), adjusted for trend;
1871 - 1950 Cowles Commission – Standard & Poor's Corporation Index of Industrial Common Stocks, adjust
trend.

Highs of the ideal cycle come in 1854.2, 1863.4, 1872.6, 1881.8, 1891.0, 1900.2, 1909.4, 1918.6, 1927.8, important cycles in the market was made some seven years ago. For a report upon this work I refer to you an article in this issue on page 219.

That article will give you a crude and preliminary “mock-up” which indicates that if the indicated cycles are real and continue, if the length, shape, amplitude, and timing of the cycles have been correctly determined, if there are no other long-term waves that need to be taken into account, if the short-term waves do not “gang up” on the long-term waves and distort them, and if no accidental factors enter into the situation, this particular 9.2-year cycle could very easily have an early low.

I am sorry that I have to include so many qualifications, but I assure you that I am not trying to hedge. I am merely trying to keep from making representations beyond my knowledge.

If you will refer back to the bottom of page 205 you will note that I inserted no qualifications whatever in regard to the 9.2-year cycle. In my opinion it is real and will continue. When I know as much in regard to the other cycles I shall report upon them and their distorting effect with equal positiveness. But until I do know all about them I must qualify my predictions.



6.2, 1955.4, 1964.6 ETC.
S OF THE IDEAL CYCLE COME IN 1858.8, 1868.0, 1877.2, 1886.4, 1895.6, 1904.8, 1914.0, 1923.2, 1932.4, 1941.6,
0.8, 1960.0, 1969.2 ETC.

B. THREE-AND-A-QUARTER-YEAR (13 QUARTER) MOVING AVERAGE OF THE VALUES CHARTED IN CURVE A, TOGETHER
TH THE IDEAL 9.2-YEAR CYCLE.

# The 9.18-Month Cycle in the Ton-Miles of the Canadian Pacific Railway

You will be interested in a study by Mr. G. Meredith Rountree of the 9.18-month cycle in the ton-miles of the Canadian Pacific Railway for three reasons:

(1) A rhythm of about 9 months in length is extremely common in all sorts of American trade and industry. In Mr. Rountree's study the period of this rhythm has been determined with great exactness, and the rhythm has been found to persist over many years.

(2) The second reason that you will be interested in this rhythm is that it provides an example of a rhythm that continued relatively undistorted through two great wars.

(3) And the third fact of general interest about this rhythm is the circumstance that it has kept on coming true after discovery. It is always comforting to have the cycles continue. There is no proof of reality quite so satisfying.

Mr. Rountree is now Assistant to Comptroller for the C.P R. Back in 1942 he was the company's Chief Statistician. At that time the company sent him to Foundation Headquarters for about a year to make a study of the rhythmic fluctuations that might be present in their business.

I have already told you about the 32.85-month rhythm he discovered in their figures (see our release of Feb. 8, 1950). You will remember that this so-called 33-month rhythm was upset completely by World War I and World War II, but that in both instances it snapped back into the standard pattern as soon as the distortions were over. That is, after World War I this cycle snapped back into the pattern that could have been determined in 1914 from pre-World-War-I behavior; after World War II, it snapped back into the pre-war pattern which was actually determined in 1942 during World War II.

During his stay at Foundation Headquarters Mr. Rountree also discovered in C.P.R. figures the well-known 9-month rhythm. However, before Mr. Rountree's work, no adequate attempt that I know about had ever been made to determine the exact period (length) of this cycle. Mr. Rountree's study is thus a milestone in cycle research, and deserves recognition as such. It is a pleasure to report upon his work.

Monthly figures for the ton-miles of the Canadian Pacific System as a whole are available from July 1903 to date. They are shown through December 1949 on Fig. 1. The seasonal pattern is clearly evident.

Deviations (percentages) of the actual data from their centered 12-month moving average are shown in Fig. 2. This chart shows the seasonal pattern more clearly, but with admixtures of random variations of one sort or another.

By methods which Mr. Rountree describes in his study, the true seasonal pattern is isolated, as nearly as may be, and is charted in Fig. 3. You will note the tremendous amplitude of the seasonal waves. For instance, on the average, in the five years next before World War II the seasonal wave extended from 25% below trend to 53% above trend—an overall move of 78%. You will also note that the war greatly minimized the seasonal pattern, reducing its fluctuation to a range of from 12% below trend to 8% above trend, or a total overall move of 20%. That is, the war had the effect of reducing the seasonal waves to about one-quarter of what they had been previously. I want you to remember this fact for comparison with what the war did to the 9-month pattern, to be seen in a moment.

Fig. 4 shows the deseasonalized figures, and a 9-month moving average run through them to serve as trend. Of course, to study the 9-month waves, Mr. Rountree needed to use deviations or percentage departures from a 9-month moving average just as in studying the 12-month or seasonal waves he had to use deviations from a 12-month moving average.

These deviations are shown in Fig. 5 which also shows, by means of a dotted line, a true 9.18-month zigzag to help you to follow the 9.18-month wave in the actual figures over the 43-year period. Crests of the ideal 9.18-month wave come in month 42 (June 1907) and every 9.18 months thereafter. The last crest came in February of 1951.

The average strength of the 9.18-month wave from the beginning of the figures through 1941 was from 13% above trend to 13% below trend, or an overall wave of 26%.

The isolation of the 9.18-month rhythm in these figures was effected in 1942, using figures through 1941. From 1941 forward the zigzag is therefore a forecast. This part of the curve has consequently been enlarged to double size so that you can see more clearly how the war affected the cycle. Some distortions both for timing and amplitude (height) are indeed visible, but nonetheless the wave is clearly evident during the war period, the distortions that occur being no more than on several occasions when there was no war. Also note that the cycle is damped down as a result of the war by only about one-half of the average amplitude of the preceding five years, as compared with three-quarters damping down for the seasonal pattern. Moreover, with the ending of the war, note the strength and the precision with which this wave reasserts itself.

Also in Fig. 5 note the strength and vigor and clarity of the 9-month rhythm all during World War I (1914-1918).

Fig. 6 shows a time chart diagramming the position in time of the highs and lows of the 9-month wave in the deviations of the seasonally adjusted figures from their 9-month moving average (see page 218).

Straight lines fitted to the time chart indicate 9.18 months as the most probable true length. For a manual on how to make and use time charts refer to the Foundation's **Technical Bulletin No. 3**, entitled **Cycle Analysis: A Description of the Hoskins Time Chart.**

Almost everyone who deals with statistics knows what moving averages are. (For example, a 9-month moving average of a series of figures might be described as a series of values obtained by averaging the first nine values of the series, then the 2nd to 10th values, then the 3rd to 11th values, and so on.)

But the knowledge of many people stops there; they do not understand the effect of a moving average upon the cycles. Some people even have the idea that in some mysterious way a 9-month moving average might somehow create 9-month waves in the deviations.

If this were true, a 10-month moving average would create 10-month waves, an 11-month moving average would create 11-month waves. This of course is nonsense, but some people seem to half believe it, notwithstanding.

To show that the 9-year wave in the figures could not be the result of the 9-month moving average, Mr. Rountree has computed the deviations, or percentages, that the deseasonalized figures are of their 11-month moving average. Of course the 9.18-month wave is present in these figures also, even stronger than before, for reasons that you can learn from the Foundation's **Technical Bulletin No. 4, Cycle Analysis: The Moving Average.** No 11-month wave appears and if you understand moving averages you would not expect one.

I hope you will study the 9-month rhythm in the figures in which you are interested, whether it be the electric potential of trees, the incidence of disease, the departures of weather, the abundance of wildlife, the variations of the sun, or the ups and downs of economic time series, and that you will let me know the results of your research.

When enough people have made studies of this sort, we will have the raw material from which we may be able to advance a theory as to the cause of these behaviors and the mechanism whereby the ultimate cause is translated into variations in the number of tons of freight offered and/or the distance it is to be hauled on a great railroad system of Canada.

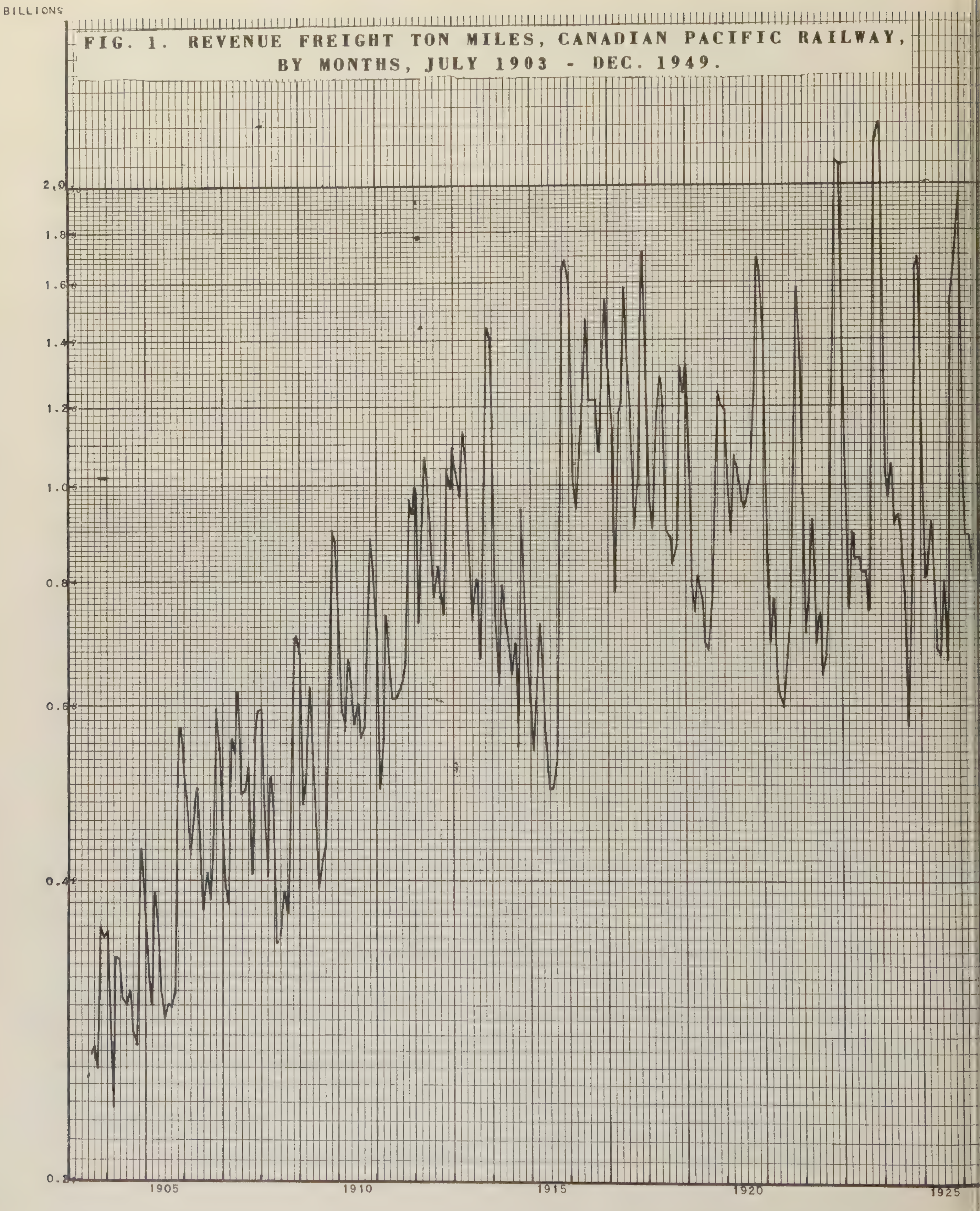
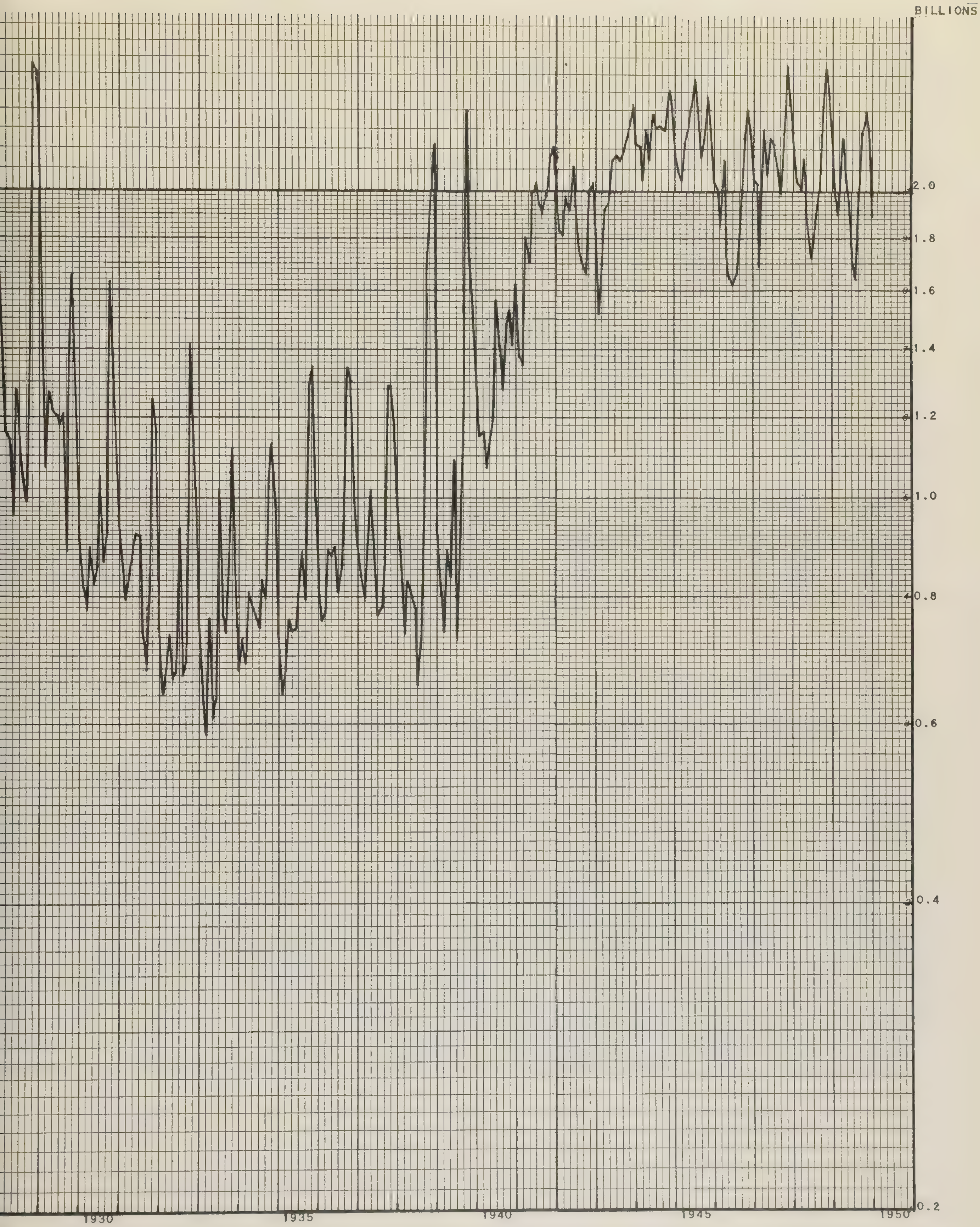


FIG. 1. REVENUE FREIGHT TON MILES, CANADIAN PACIFIC RAILWAY, BY MONTHS, JULY 1903 - DEC. 1949.


BILLIONS
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1930
1935
1940
1945
1950

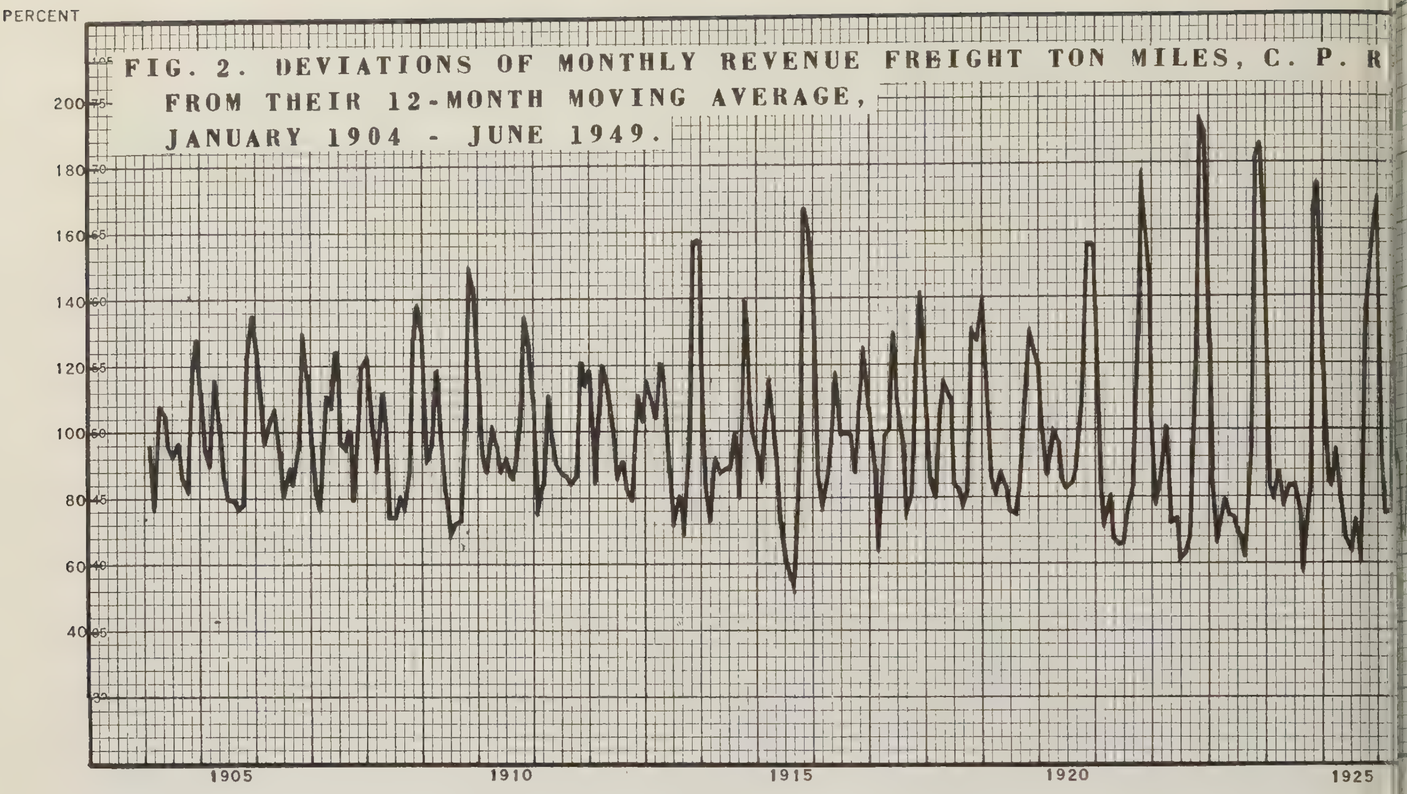


FIG. 2. DEVIATIONS OF MONTHLY REVENUE FREIGHT TON MILES, C. P. R

FROM THEIR 12-MONTH MOVING AVERAGE,

JANUARY 1904 - JUNE 1949.

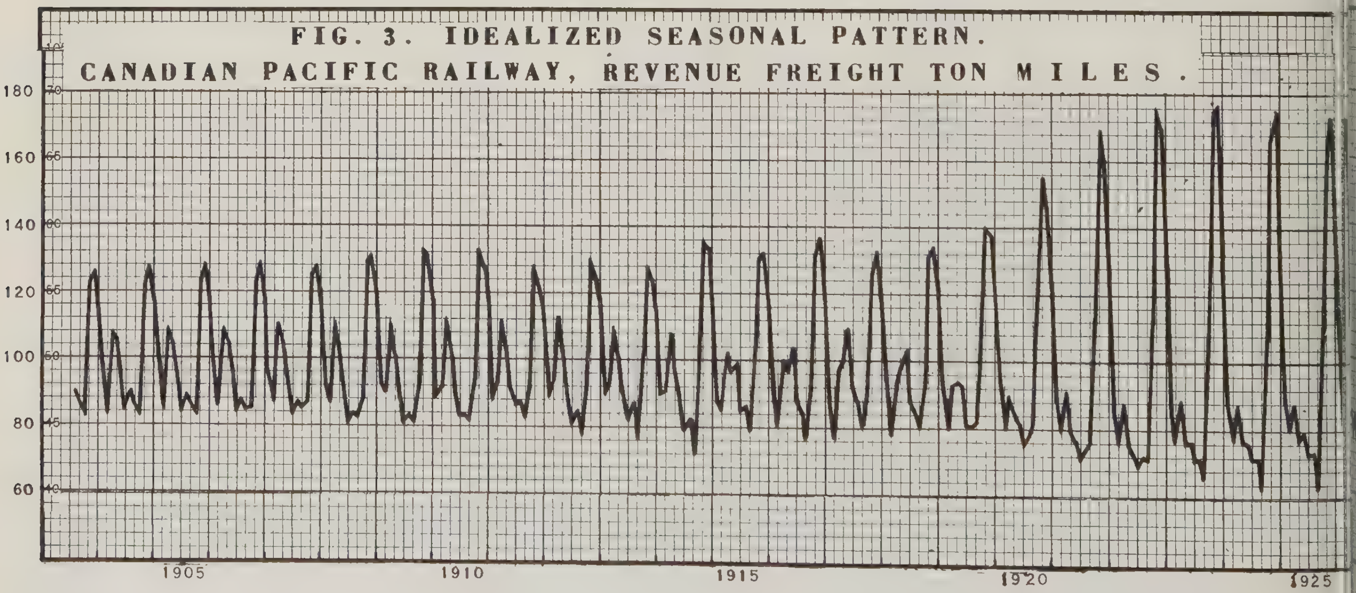
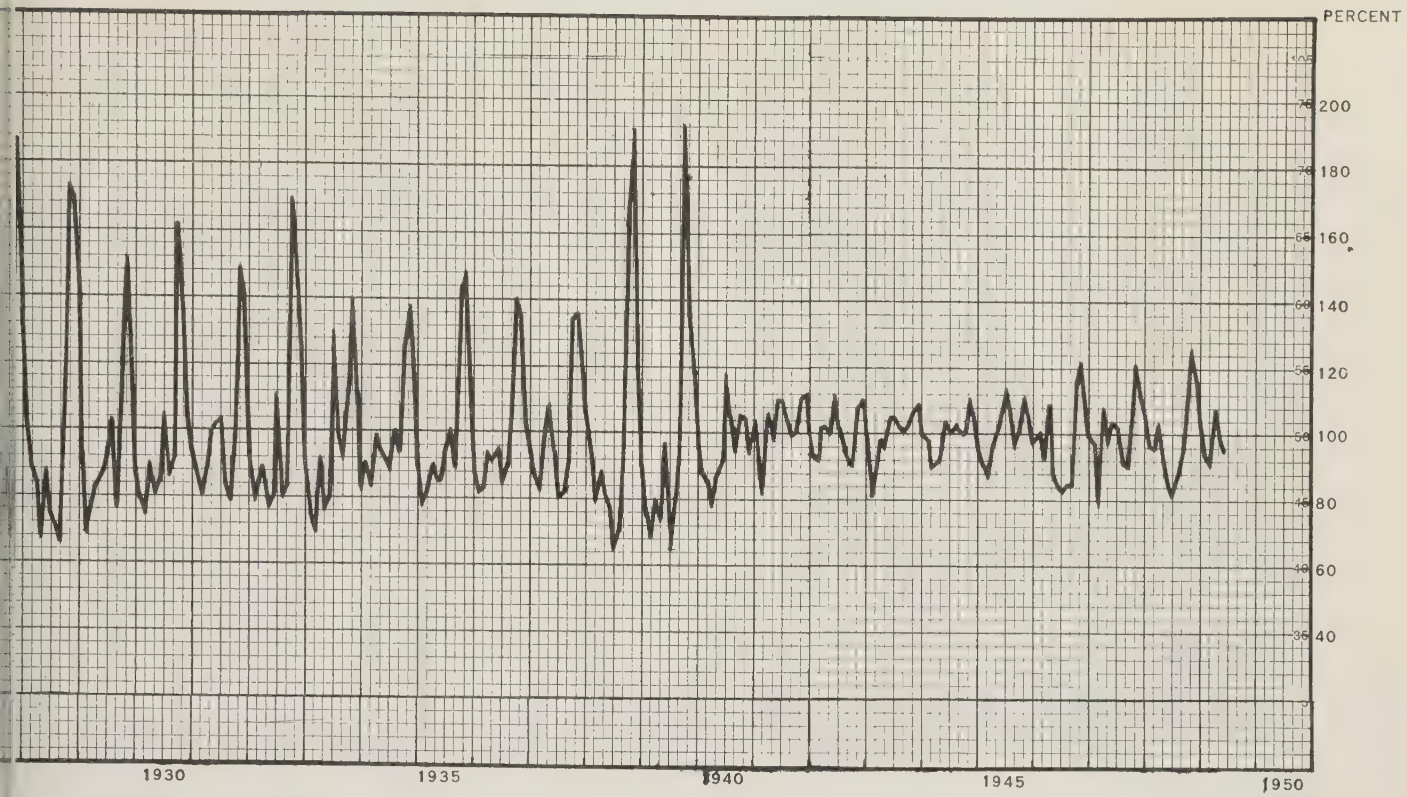
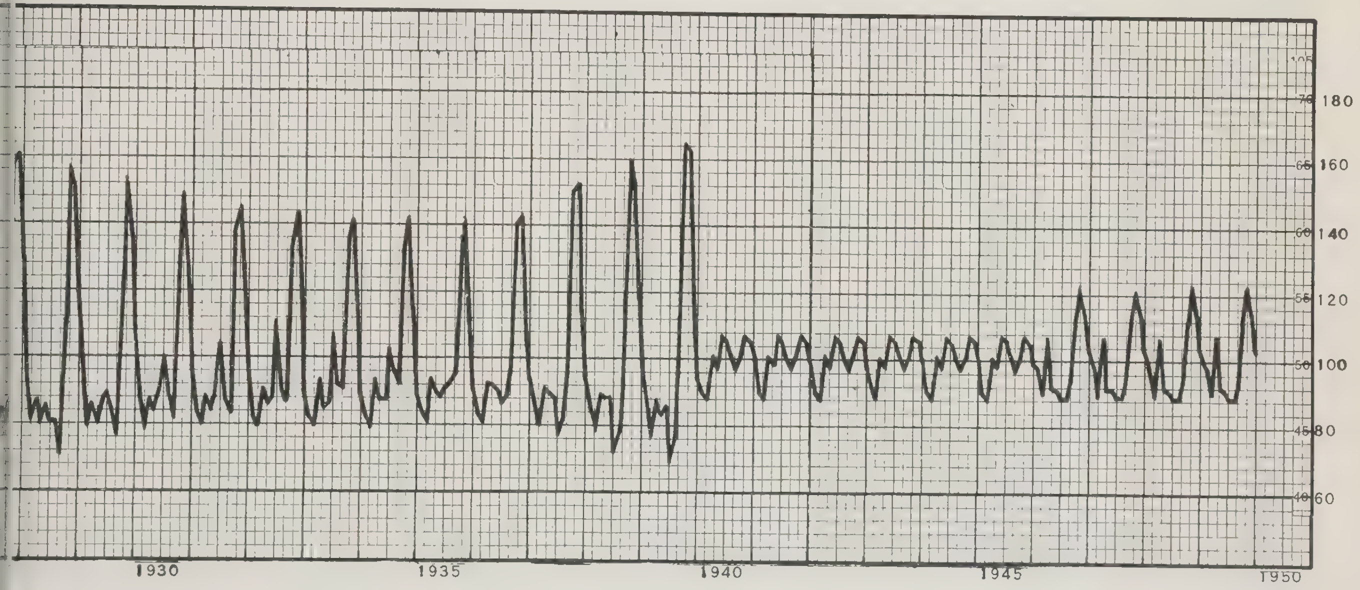


FIG. 3. IDEALIZED SEASONAL PATTERN.

CANADIAN PACIFIC RAILWAY, REVENUE FREIGHT TON MILES.


PERCENT
200
180
160
140
120
100
80
60
40
1930
1935
1940
1945
1950


180
160
140
120
100
80
60
1930
1935
1940
1945
1950

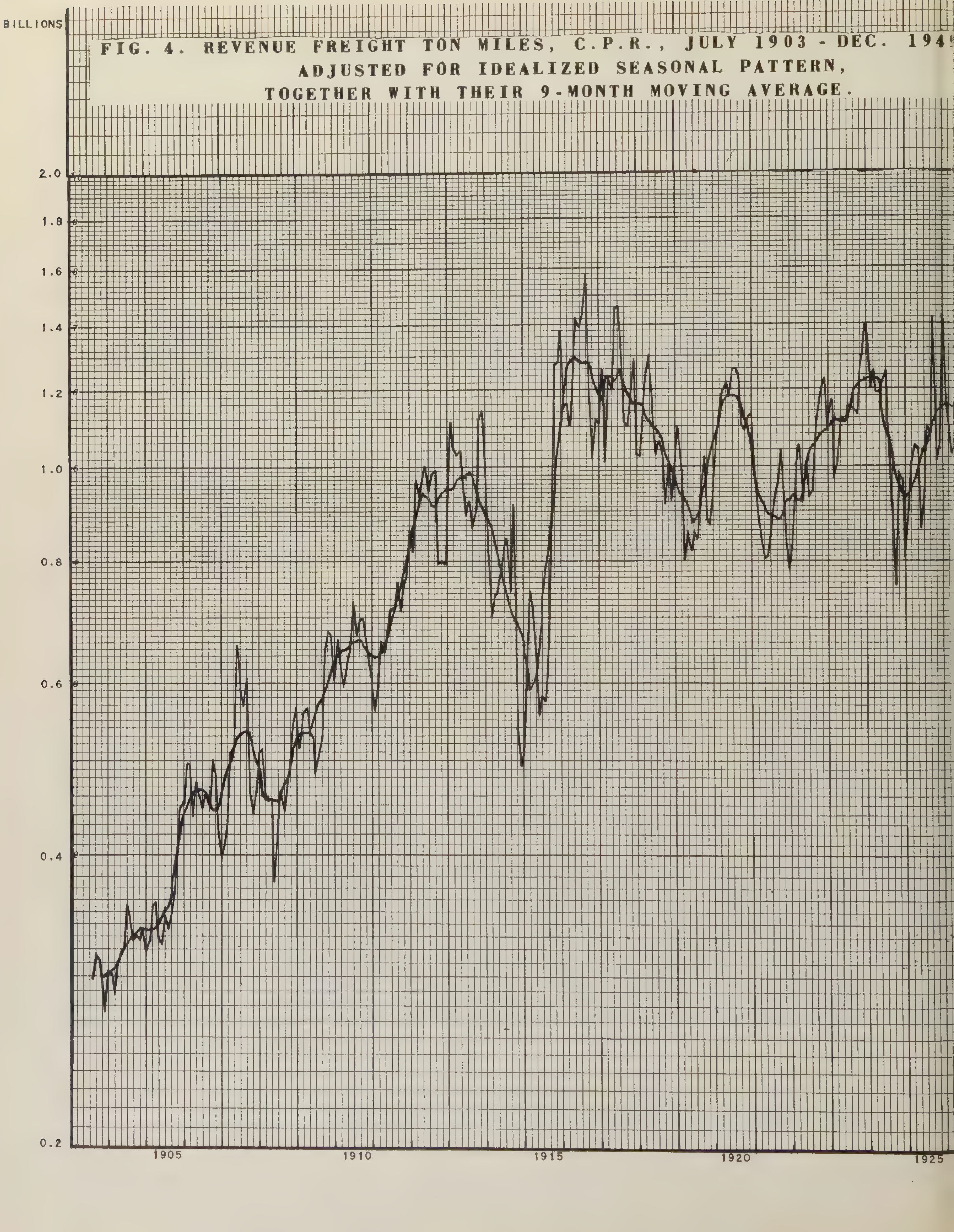
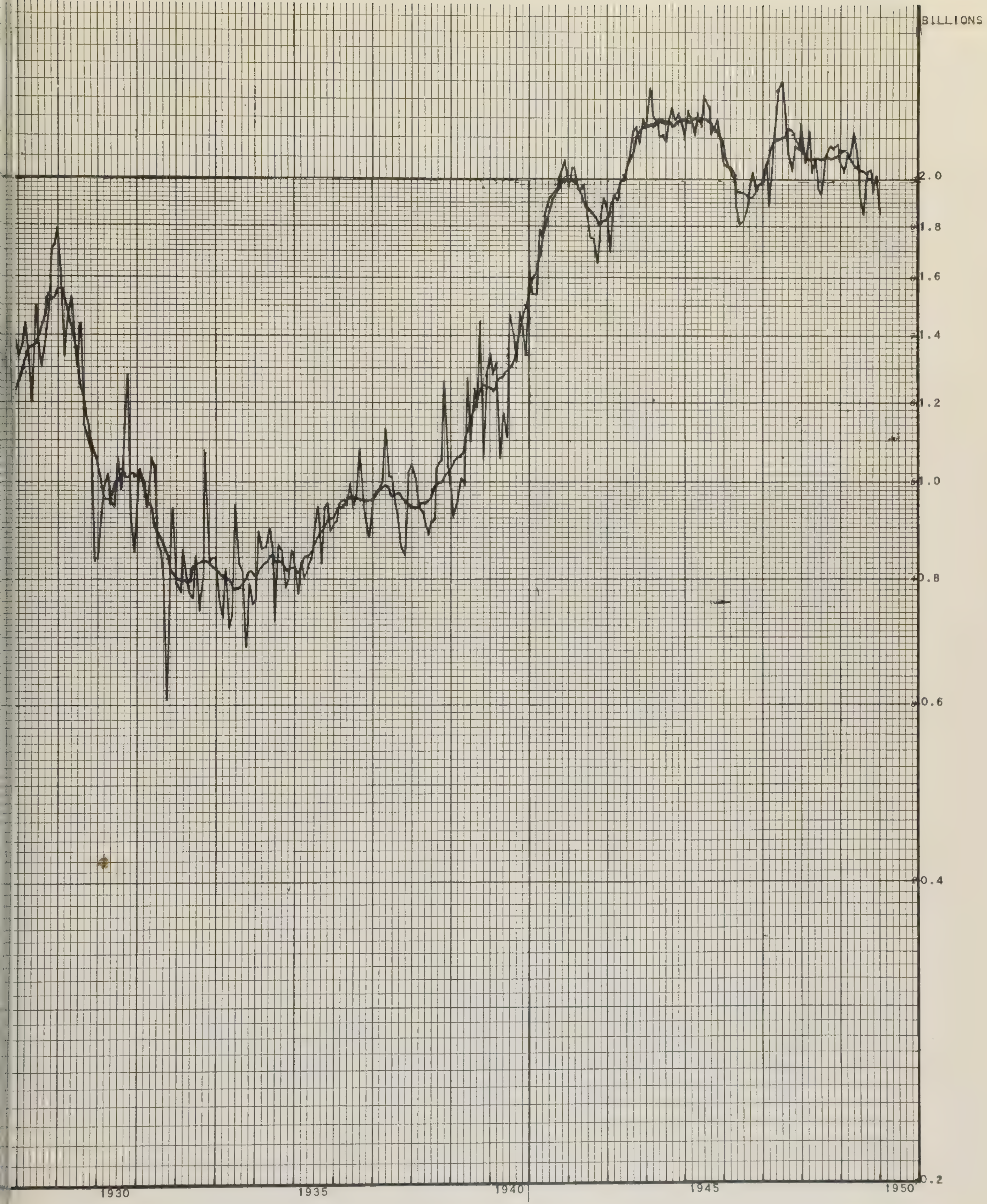


FIG. 4. REVENUE FREIGHT TON MILES, C.P.R., JULY 1903 - DEC. 194
ADJUSTED FOR IDEALIZED SEASONAL PATTERN,
TOGETHER WITH THEIR 9-MONTH MOVING AVERAGE.


BILLIONS
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1930
1935
1940
1945
1950

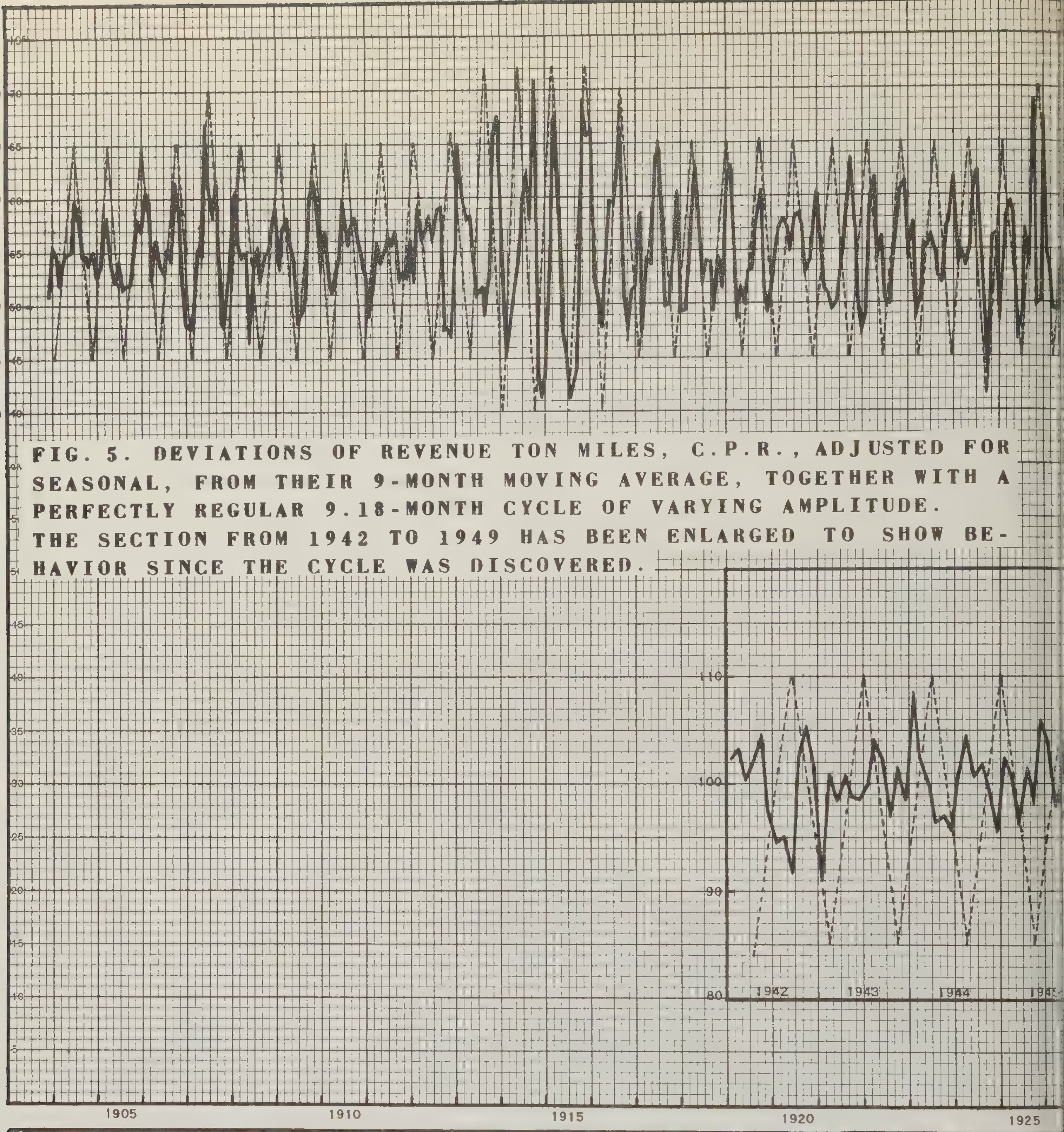


FIG. 5. DEVIATIONS OF REVENUE TON MILES, C.P.R., ADJUSTED FOR SEASONAL, FROM THEIR 9-MONTH MOVING AVERAGE, TOGETHER WITH A PERFECTLY REGULAR 9.18-MONTH CYCLE OF VARYING AMPLITUDE. THE SECTION FROM 1942 TO 1949 HAS BEEN ENLARGED TO SHOW BEHAVIOR SINCE THE CYCLE WAS DISCOVERED.

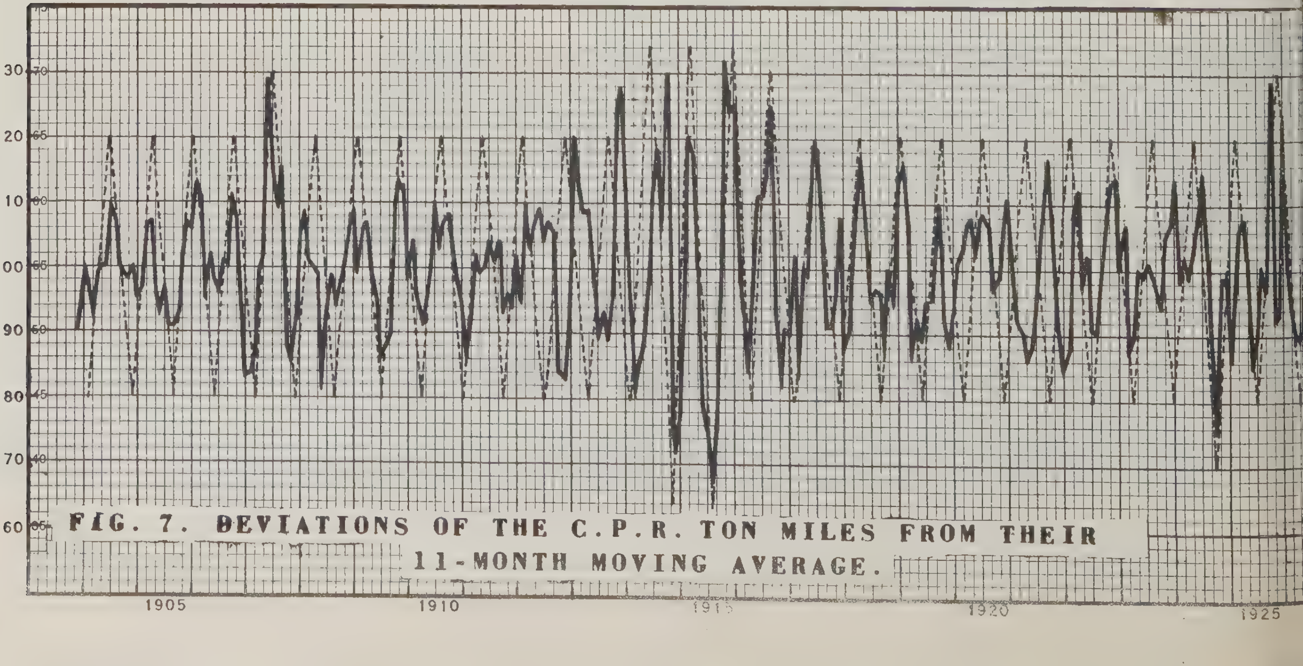
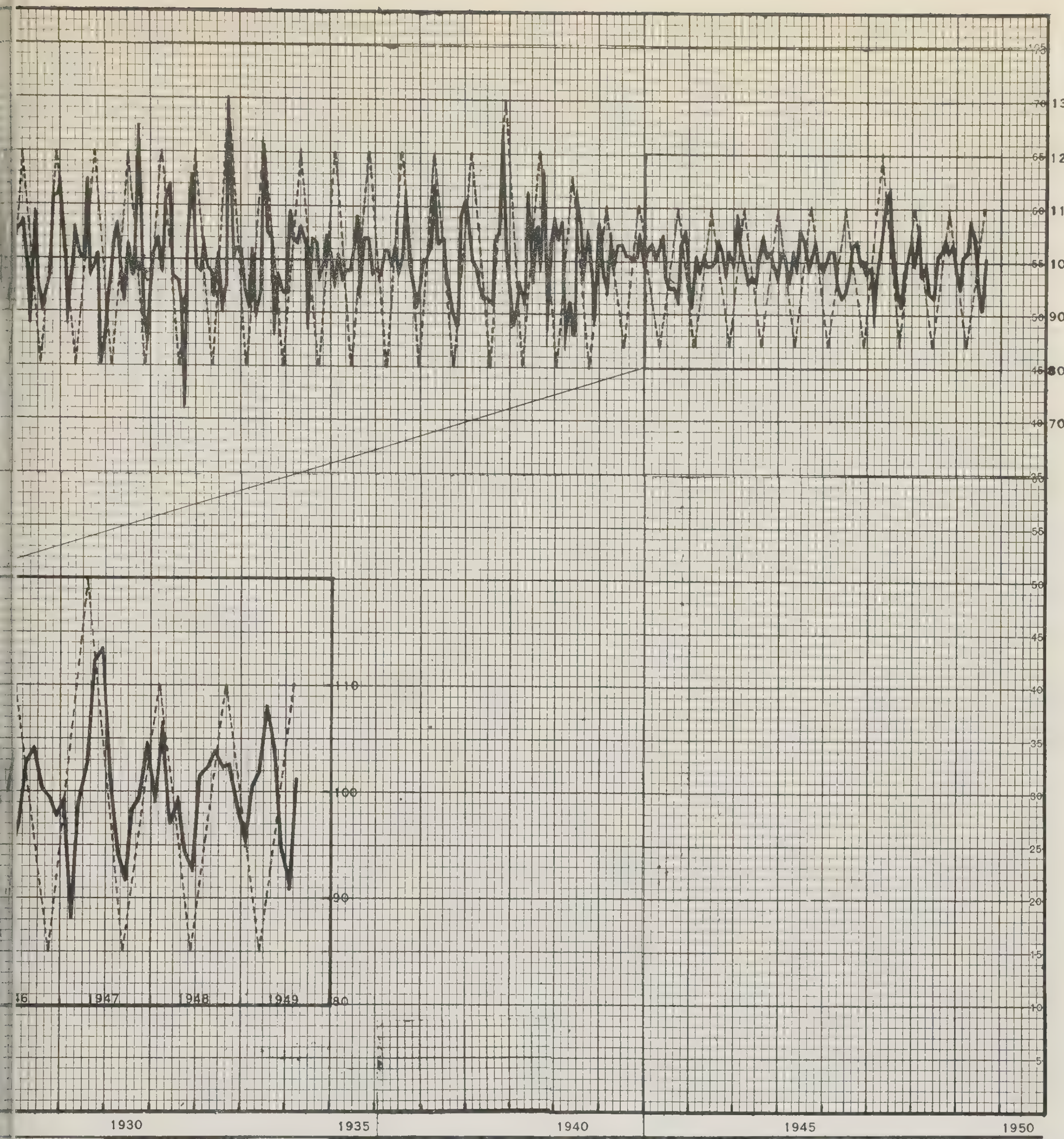


FIG. 7. DEVIATIONS OF THE C.P.R. TON MILES FROM THEIR 11-MONTH MOVING AVERAGE.


130
120
110.
100
90
80
70
110
100
90
80
46
1947
1948
1949
1930
1935
1940
1945
1950

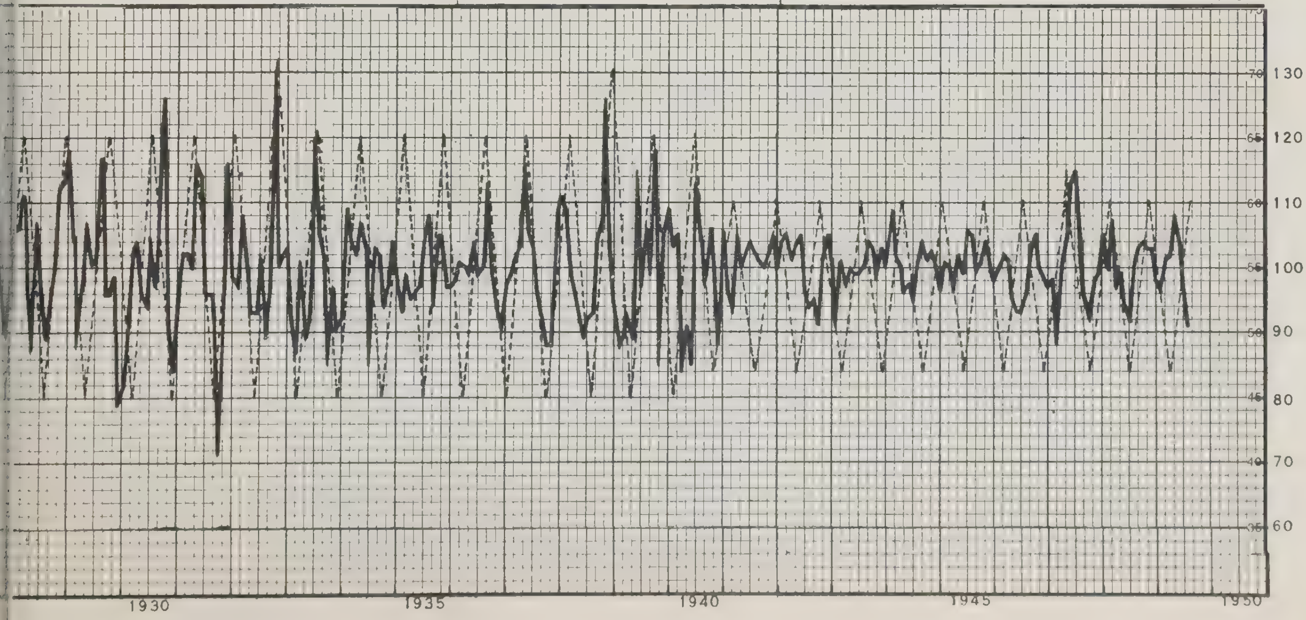
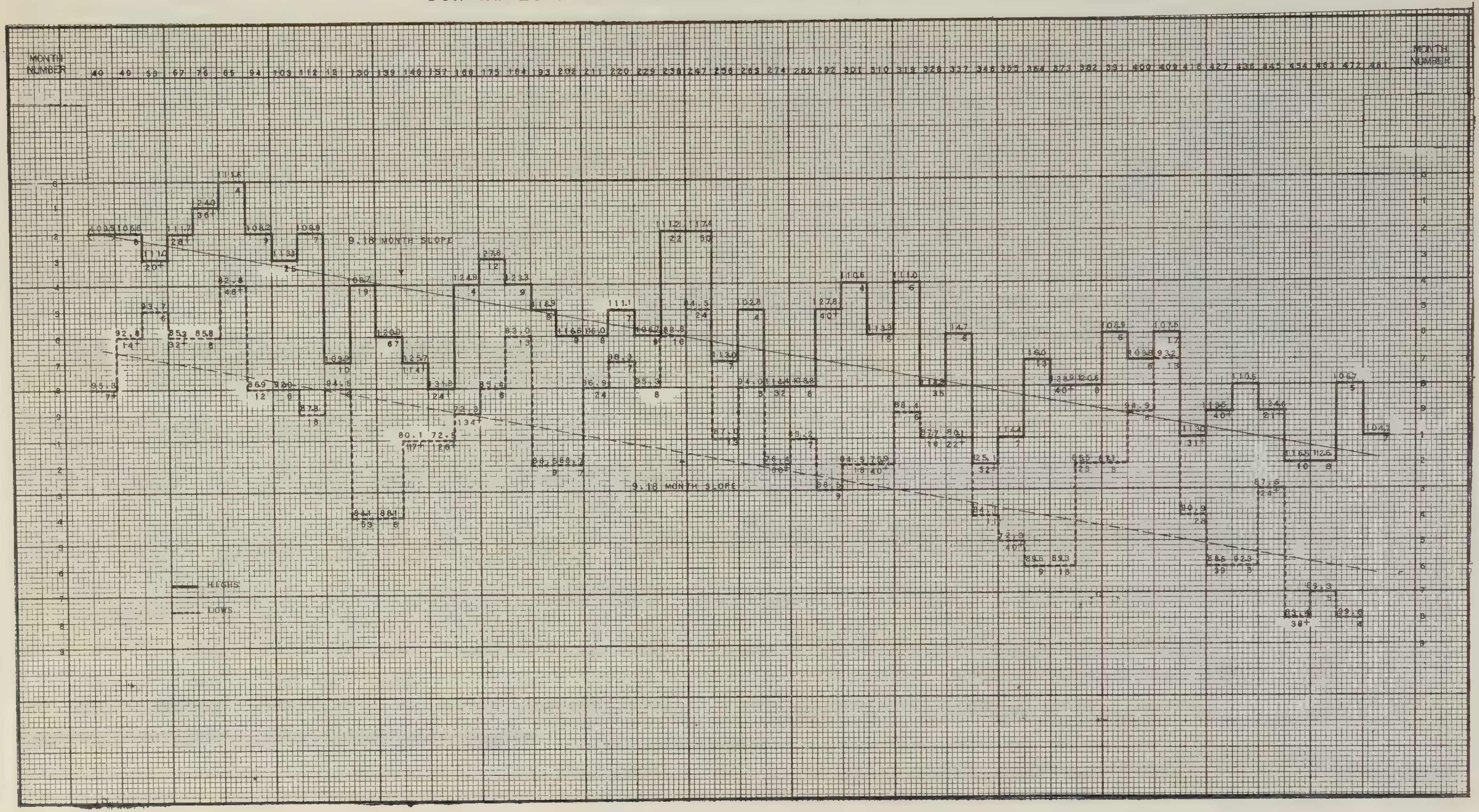

130
120
110
100
90
80
70
60
1930
1935
1940
1945
1950

FIG. 6. A 9-MONTH TIME CHART OF THE DEVIATIONS OF THE C.P.R. TON MILES FROM THEIR 9-MONTH MOVING AVERAGE.



# Cycles in the Stock Market
# A Preliminary Projection to 1990

IN an article in the March report I told you about some preliminary work that I did in 1943 and 1944 in respect to cycles in the stock market.

In that article I gave you the lengths of the cycles that were indicated by that preliminary analysis.

I explained that the length, shape, amplitude, and timing of the various waves had been determined only crudely and that in a number of instances, particularly in respect to the shorter waves, the work had not even been done to make sure that the indicated waves were rhythmic and repetitive.

Finally, I also explained some of the limitations inherent in any cycle analysis of a general index of stock market prices over a long period of time.

The work of 1943 and 1944 was based upon railroad figures, 1854-1870 and upon the entire market, industrials, rails, and utilities combined, 1871-1943. The work was divided into two parts. For the cycles shorter than 4½ years I used monthly figures. For cycles longer than 4½ years I used annual figures.

### Ten cycles over 4½ years in length

You will doubtless recall that the preliminary reconnaissance indicated the possibility of ten cycles over 4½ years in length.

I think it will interest you to see a synthesis of these longer cycles (over 4½ years in length) from 1854 to 1943 inclusive, and to see a projection of this synthesis, made at that time, for the period from 1944 through 1990. This synthesis is shown by Curve A in Fig. 1 on the two pages next following. Curve A is an exact reproduction of a chart which was drawn and signed by me on January 25, 1944. Copies were given at the time to a dozen or more people in order to have corroborative evidence of the date when the projection was made.

Below Curve A I have drawn, in Curve C, the **actual** year-by-year values adjusted for trend. Curve C of course has all the short term cycles included as well.

(It should be noted at this point that Curve C represents rails, 1854-1870, and industrials only, 1871-1950.)

To get a fairer comparison between synthesis and actual, I have drawn, in Curve B, a 3-year moving average of the values charted in Curve C.

I have included Curves C and B so that you can see the extent to which the synthesis charted in Curve A describes the actual behavior 1854 to 1943 inclusive, and so that you can see the extent to which the projection made early in 1944 has come true in the seven years that have elapsed since it was made.

### Limitations and qualifications

In addition to the limitations attendant upon all cycle analyses of general stock market indices over any long period of time, as discussed in the March report, the particular study being reported upon here has additional limitations:

First, I used annual figures. One cannot possibly hope to do sufficiently accurate work in respect to medium and short cycles using annual figures.

Second, in a series as short as this one, waves of 10 years or over can repeat only nine times or less. This fact necessarily makes for inaccuracy in respect to all such waves.

Third, you must remember that this synthesis takes no account of numerous important waves shorter than 4½ years. Some of these shorter waves are very important indeed. Moreover, when two or three of them happen to have peaks or troughs which come at the same time, they can introduce fluctuations which distort the longer waves very considerably.

Fourth, you must bear in mind that the correspondence between the synthesis and the actual behavior, adjusted for trend, up to the time the work was done (1944), has very little significance. By taking **enough** waves of the right shape, length, amplitude (height), and timing, you can reproduce any curve (with certain exceptions that are not in point here) with any degree of exactness that you wish. It is

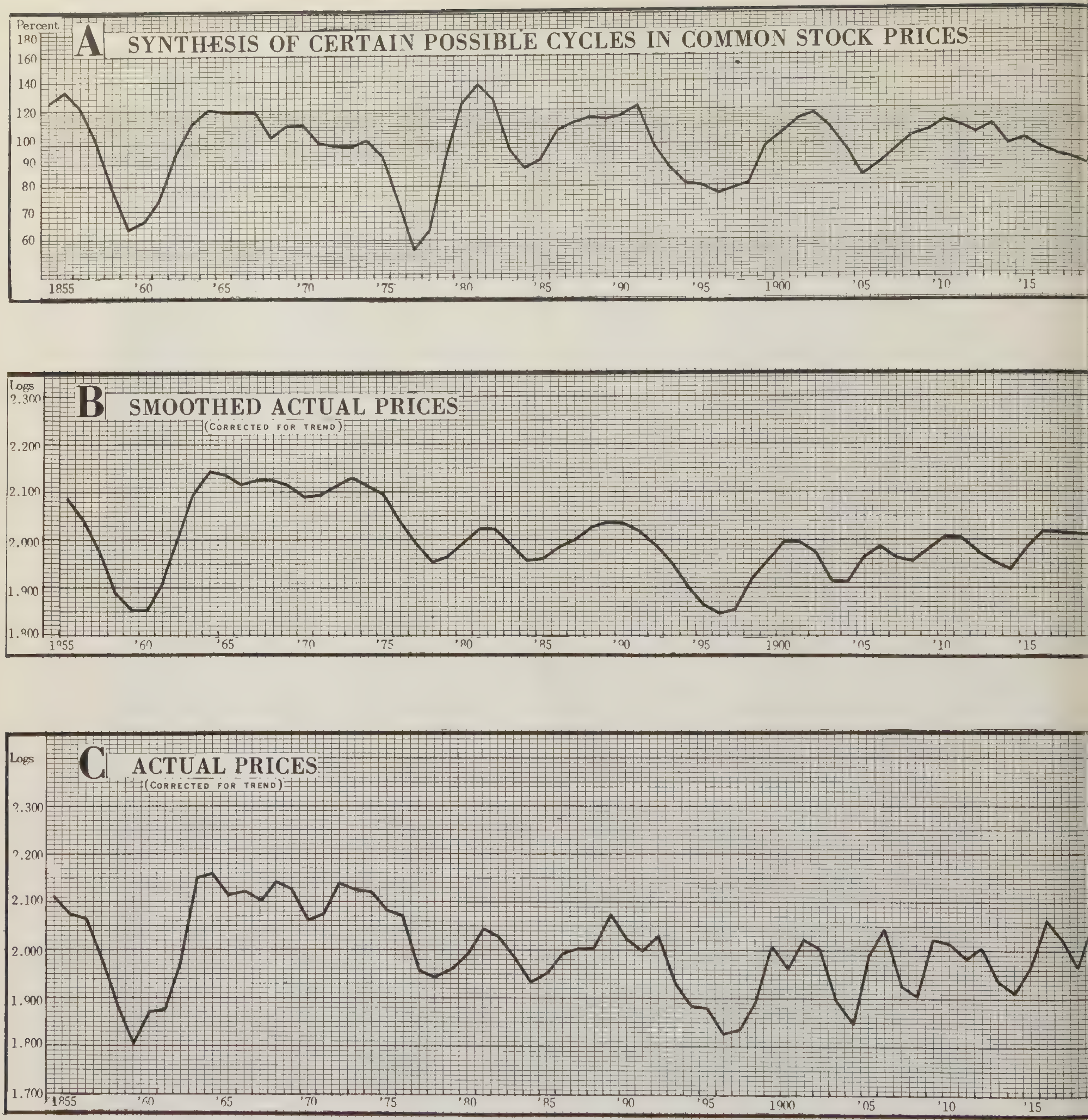
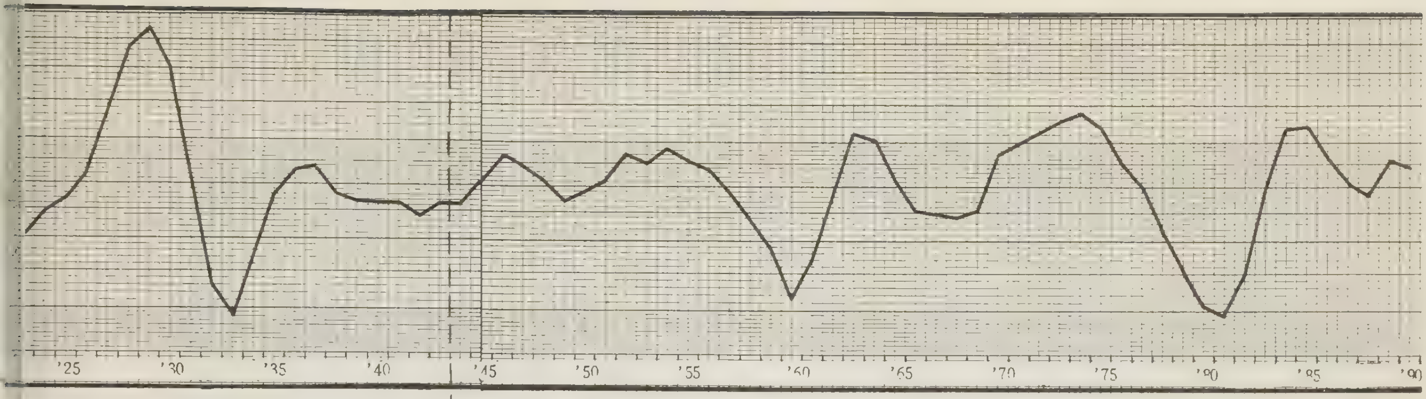
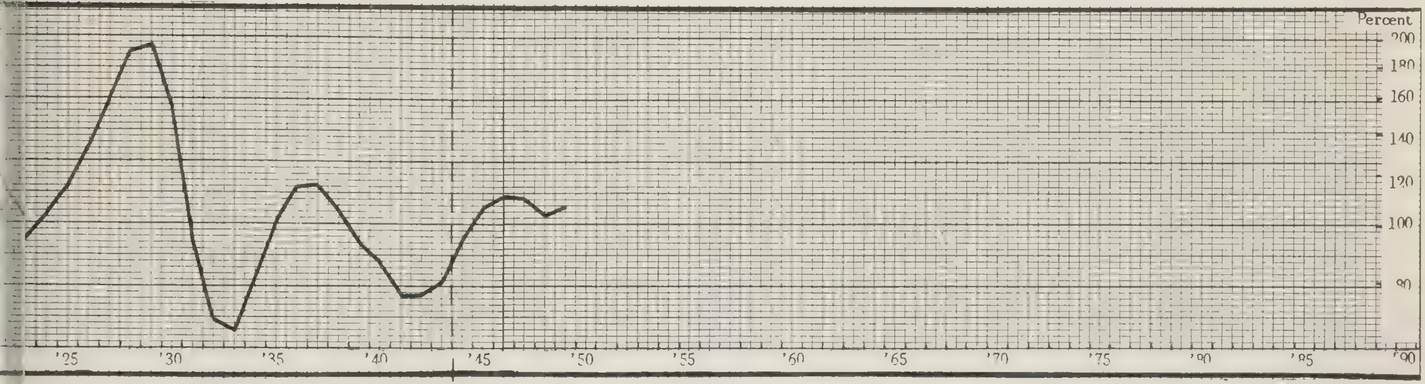
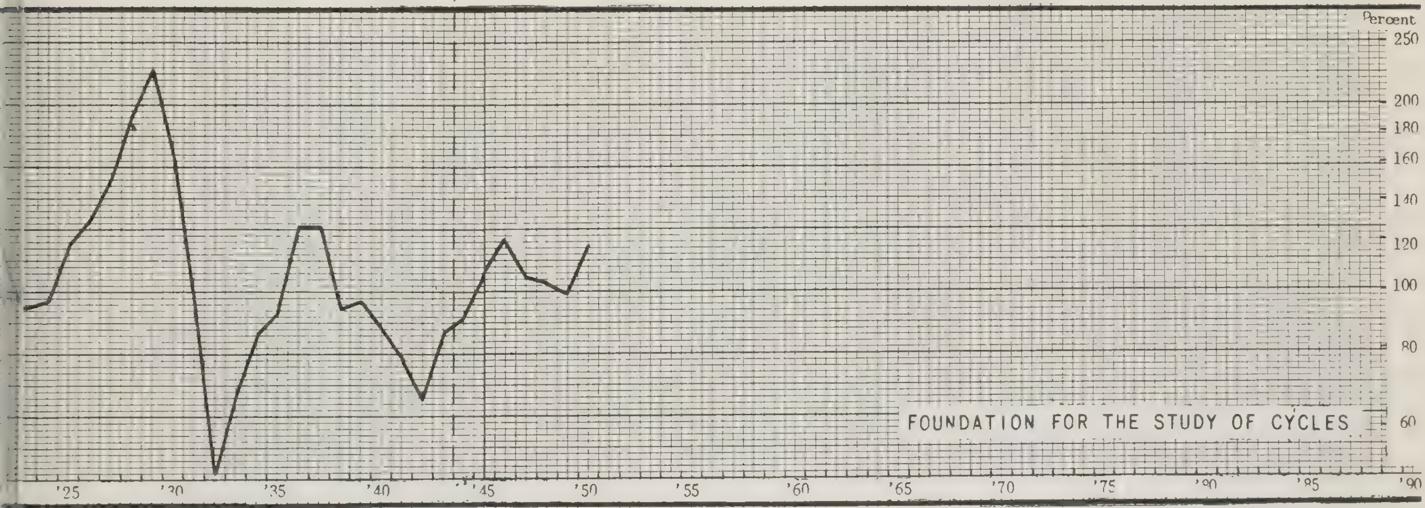


FIG. 1. A. SYNTHESIS OF TEN CYCLES OVER 4½ YEARS IN LENGTH WHICH MAY BE PRESENT IN COMMON STOCK PRICES, 1854 - 1990. THIS CHART, PREPARED ON JANUARY 25TH, 1944, IS PRINTED CHIEFLY TO SHOW THAT THESE OTHER CYCLES, **IF THEY EXIST**, COUL BADLY DISTORT THE LOW OF THE PRESENT WAVE OF THE 9.2-YEA CYCLE. THE WORK IS PURELY PRELIMINARY AND IS NOT TO BE RELIE UPON AS A FORECAST. (RATIO SCALE).

B. THREE YEAR MOVING AVERAGE OF THE ACTUAL COMMO STOCK PRICES, ADJUSTED FOR TREND, AS SHOWN IN CURVE C BELOW







THIS CURVE IS MORE COMPARABLE WITH THE SYNTHESIS THAN THE ACTUAL DEVIATIONS SHOWN BELOW, BECAUSE SHORT TERM FLUCTUATIONS HAVE BEEN ELIMINATED. (RATIO SCALE.)

C. COMMON STOCK PRICES, 1854 — 1950, ADJUSTED FOR TREND. PRICES 1854 - 1870, CLEMENT BURGESS INDEX (LARGELY RAILROAD STOCKS) ADJUSTED FOR TREND AND RAISED BY 7.4%. PRICES 1871 - 1950, COWLES COMMISSION - STANDARD & POOR'S CORPORATION INDUSTRIAL COMMON STOCK PRICE INDEX, ADJUSTED FOR TREND. (RATIO SCALE.)

not the overall correspondence between the two curves from 1854 to 1943 that is important; the important thing is the regularity of the rhythm displayed by each particular cycle considered separately. This I shall tell you about from month to month, as fast as time permits.

Fifth, as you doubtless know, usually the best way to make a cycle analysis is, first, to find the short cycles and remove them one after another so that the long cycles are free from the distortions introduced by the presence of the short cycles. Only when this has been done is one safe in proceeding to attempt to identify and pin down the longer cycles. In this analysis this procedure was not followed for very good reasons.

Sixth, in dealing with longer cycles one should have at one's disposal the results of similar studies in respect to very long series of figures, or in respect to other series of figures where the wave shows clear and undistorted. Neither of these conditions was met in the analysis I am talking about because it was not intended to be anything except a preliminary analysis to be verified and refined at a later date. The results of the analysis were not intended to be put to practical use, in their crude state.

### Synthesis not a forecast

As a result of all these qualifications, it should be clear that the projection from 1943 forward must not be thought of as a forecast but must be considered as merely the results of a reconnaissance survey; a kind of " mock-up " to indicate possible future behavior, **if** the indicated cycles are real and continue, **if** the length, shape, amplitude, and timing of the cycles have been correctly determined, **if** there are no other long-term waves that need to be taken into account, **if** the short-term waves do not " gang up " on the long-term waves and distort them, and **if** no accidental factors enter into the situation.

### Cycles to be reported upon individually

Over the course of time I plan to report to you in regard to each of the long-term cycles that entered into this synthesis. I am starting these cycle-by-cycle reports for you in this issue by a report upon the 9.2-year waves that have been present in stock market figures for as far back as data are available. You will find this report on page 204. Other reports in regard to other cycles in the stock market will appear in early issues.

You must keep in mind that these reports in regard to individual cycles cannot be considered separately. That is the chief reason behind my giving you at this time the results of the preliminary work I did in 1943 and 1944. I want you to realize that **no matter how important or regular the 9.2-year cycle or any other cycle has been in the past, it is always possible and even likely that, in any given instance, the combination of other cycles will distort it or even upset it. It is very dangerous to rely upon partial information.**

When all of these long-term waves are reported upon I plan to make another synthesis for you which will take account of any changes of length, amplitude, shape, or timing that result from a more careful repetition of the work, or from anything I may have learned in the seven years since the old synthesis was made.

### Results of harmonic analysis to be included

In addition to reporting to you upon the ten long-term cycles that were indicated in the preliminary analysis of stock market prices, I plan to report to you also upon such other long-term cycles as may be indicated by the proposed multiple harmonic analysis of stock market prices. (You will recall that we are making such a study for you through the very great generosity of one of our members, who has supplied the money for the work, and of the Mico Instrument Company of Cambridge, Massachusetts, who have agreed to place one of their latest machines at our disposal so that this work can be done.) These other long-term cycles will also be included in the new synthesis to be made at a later date.

### Short term cycles to be included later

Finally, in addition to the long-term cycles, as far as possible I will give you the details in regard to the work done in 1943 and 1944 in respect to short-term cycles. I shall also include the indications in connection with short-term cycles revealed by the harmonic analysis. I plan eventually to incorporate these short-term cycles as well as the long-term cycles into the synthesis.

# The 22-Year Cycle in the Advertising Efficiency of the Lydia E. Pinkham Medicine Company

FROM 1888 until 1950, the Advertising Efficiency Index of the Lydia E. Pinkham Medicine Company has fluctuated in a cycle of about 22 years in length. A chart of the advertising efficiency curve for this period and a diagram of a perfectly regular 22-year cycle are shown below in Fig. 1.

This material has been made available to you through the great kindness of Mr. Charles H. Pinkham, of that company, one of our members, who developed the Index and who discovered the cycle in it.

As you can see by looking at the chart, crests of the ideal wave come in 1896, 1918, and 1940. The next crest is due in 1962. Troughs fall symmetrically, in relation to the crests, in 1885, 1907, 1929, and 1951. The median overall amplitude is 35% of trend.

This series of figures provides another example of the 22-year cycle which has been found in several other series of figures, including sunspots with alternate cycles reversed (200 years), wholesale prices in the United States (120 years), and Dr. Wheeler's Index of International Conflict (540 years).

For those who are interested in the construction of the Advertising Efficiency Index, it is described on page 234.

I am always glad to be able to give you another example of a cycle, but in this particular instance I find myself much more interested in Mr. Pinkham's reaction to the existence of the cycle than I am in the cycle itself. Another cycle is a commonplace, but finding someone who knows how to use this information is well nigh unique. Listen to Mr. Pinkham as he writes to the officers and directors of the company:

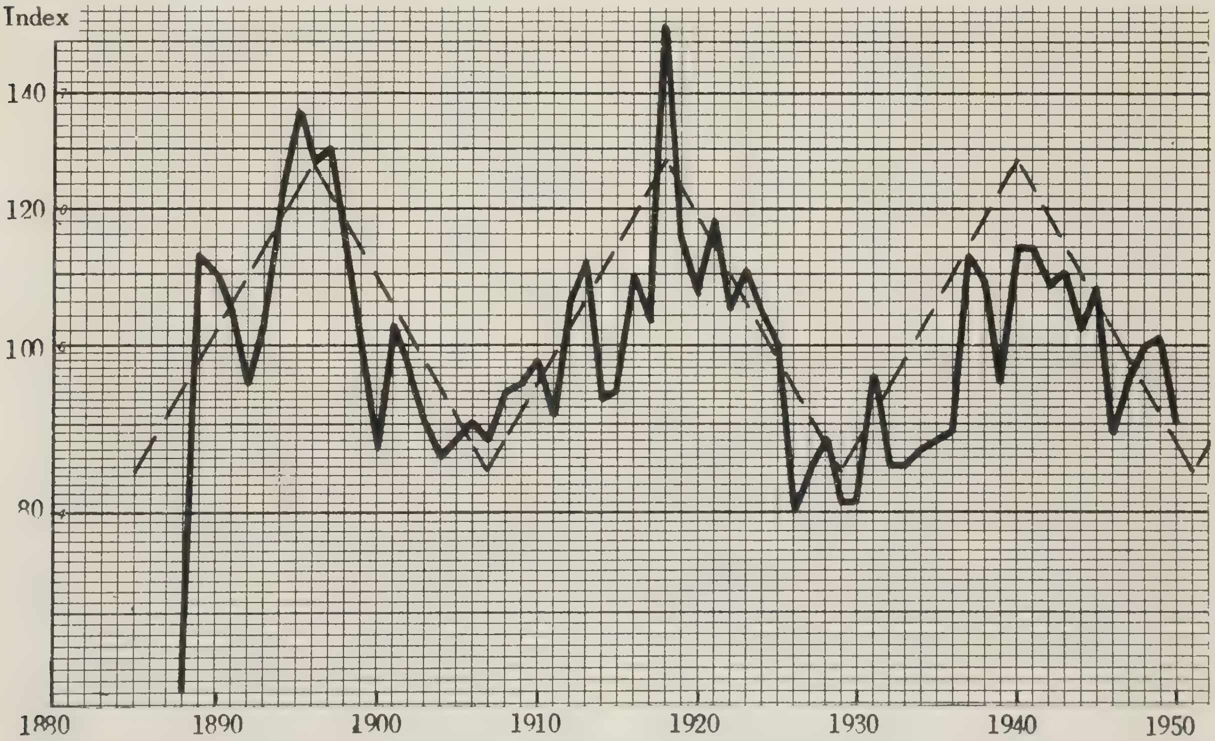


Fig. 1. Advertising Efficiency Index of the Lydia E. Pinkham Medicine Company for the 63 year period 1888 - 1950, together with an absolutely regular 22-year cycle, projected to show future tendencies if this cycle continues. (Ratio Scale.)

**Recommendations**

" 1. We should admit the possibility that the cyclical force may be a reality, and we should make a combined effort to confirm (or disprove) the existing evidence.

" 2. If we convince ourselves that the cycle presents a practical problem, we should all cooperate in learning more about it so that we can 'break' it in its unfavorable phase and get the most help from it in its favorable phase.

" 3. We should make use of all available 'know-how' in increasing the effectiveness of our advertising. This can be done primarily by continuing to strengthen our copy and by pin-pointing our advertising in the most responsive markets.

" 4. We should make a long-range plan for introducing new products that are not influenced by the 22 1/5-year cycle.

" 5. We should plan to hit a peak in sales 10 or 15 years from now; and we should make sure at that time that our costs are low enough to permit us to hold our sales volume (by additional advertising) through our next depression. "

Elsewhere in a memorandum in regard to this cycle in the business of the Lydia E. Pinkham Medicine Company, Mr. Pinkham said,

" The force of the cycle can no longer be ridiculed. To refuse to recognize it may prove disastrous to the business.

" Our usual reaction when we hear about this cycle for the first time is a feeling of depression and hopelessness. Our natural desire is to close our minds.....

" The idea of the cycle is, of course, fantastic...like the atom bomb. It took an explosion of the bomb to prove its reality to most of us.....

" Our purpose in writing this report is .....to bring the whole subject of the cyclical force out into the open so that it can be freely discussed as a PRACTICAL problem.

".....the cyclical force cannot be considered as irrelevant. It is important that we know where we are on our cycle... particularly if we are working on a long range plan.

" In our opinion we HAVE 'broken' the cycle in the last four years. And we can break it even more by advertising as scientifically as possible.

" Another reason why the cyclical force should be freely discussed by all of us is that we should learn more about it. Until now it has been a one-man project. It is too important for this. We should all make whatever contribution we can to a thorough study of it. The more we know about the cycle, the easier it will be to 'break' it.

" For example, How does the cycle affect our advertising efficiency? Is the effect a secondary reaction to the nervous stress accompanying the economic ups and downs as Mills suggests? Or is it a secondary reaction to a health cycle as Professor Huntington maintained? Dr. Petersen's disease charts would seem to bear this out.

" If, then, we are contending with a health cycle, is it a cycle of all female troubles...or of female pain...or of symptoms of the menopause? Are Cardui and Pierce on this same cycle? And how about Midol, Anacin, Aspirin?

" Furthermore, is the cycle world-wide? Is its effect reversed in our Southern hemisphere? (See 'The Law of Sunspot Polarity' on page 1 of the appendix.) Will the increase in our advertising efficiency come equally in all parts of the United States and Canada? Or will the efficiency start increasing in the North and make its way toward the equator? There is some meager evidence that this may be the case.

" If the executives of the company and the agency are not afraid that they will 'lose face' by admitting the possibility that the cycle is exerting substantial influence upon our business, then we can combine our efforts in finding ways to combat this cyclical influence. Later we can use it to our advantage.

" At the present time this force is a 'head-wind' that is holding us back. But if we work together we can buck this 'head-wind.' In a few years it will become a 'tail-wind' which may help us to attain unprecedented sales."

I think you will agree with me that in Mr. Pinkham we have a man who isn't one to take the cycle lying down. That is the way it should be. What is the use of learning about the laws of nature unless we can adapt ourselves to take advantage of them?

# The 18⅓-Year Cycle in Building Construction

LAST month I showed you the 18 1/3-year cycle in a series of figures never before reported upon for cycles, namely an index of the number of residential building projects, 1856-1950.

This month I want to bring up to date the chart on pages 118 and 119 of **CYCLES—The Science of Prediction** showing the 18 1/3-year cycle in all kinds of construction—not merely residential.

If you have a copy of **CYCLES** you may remember that for the period from 1830 to 1936 Mr. Dakin and I used Warren & Pearson's Composite—Riggleman, Wenzlick, and 120-City—Index of building activity and, overlapping it, from 1925 forward, the F. W. Dodge Corporation's **value** of construction contracts awarded in thirty-seven states.

For my own use I have brought this chart up to date through 1950 but, as we are in an era of " funny money, " comparisons in dollars do not mean much any more. (Present dollars are like a woolen tape line, after washing. It takes a hundred foot tape to measure a fifty foot lot!) This being so I have discarded this chart; I think it would be misleading to show it to you. However you can draw it for yourself from the data shown on this page if you want to.

Instead, I have computed for you, year by year from 1925 forward, the number of square feet of **floor area** of the contracts awarded in thirty-seven states for non-residential buildings and residential buildings combined. For the actual figures see table below on this page. I have plotted these values for you in conjunction with the Composite Index, and present the result in Fig.1., pages 226/227.

In interpreting this chart bear in mind that the Composite Index 1830-1936 was adjusted for trend, and that the square foot figures for 1925-1950 are not. This is why the current cycle would normally have been above the last one, even if there had been no war.

However, the peaks in 1942 and 1950 can almost certainly be attributed to war and fear of war, and the trough of '43, '44, and '45, coming just when the 18 1/3-year cycle was due for its crest, was definitely a wartime phenomena, creating shortages which had to be made up later.

The future, as always, is on the laps of the gods, but, if the cycles of the past prevail, sometime in the next few years there should be an important setback in the amount of building construction in this country.

CONSTRUCTION CONTRACTS AWARDED IN 37 STATES
F. W. DODGE CORPORATION

| YEAR | MONTHLY AVERAGE FLOOR AREA IN MILLIONS OF SQUARE FEET | | | VALUES IN MILLIONS OF DOLLARS | |
|---|---|---|---|---|---|
| | NON-RESIDENTIAL | RESIDENTIAL | TOTAL | MONTHLY AVERAGE | ANNUAL TOTAL |
| 1925 | 30.1 | 46.6 | 76.7 | 500.5 | 6,006 |
| 1926 | 29.3 | 43.4 | 72.7 | 531.7 | 6,380 |
| 1927 | 28.6 | 41.2 | 69.8 | 525.3 | 6,304 |
| 1928 | 32.4 | 47.4 | 79.8 | 522.4 | 6,269 |
| 1929 | 32.7 | 32.3 | 65.0 | 479.2 | 5,750 |
| 1930 | 22.1 | 19.2 | 41.3 | 376.9 | 4,523 |
| 1931 | 14.0 | 15.9 | 29.9 | 257.7 | 3,092 |
| 1932 | 6.6 | 6.1 | 12.7 | 112.6 | 1,351 |
| 1933 | 5.9 | 6.1 | 12.0 | 104.6 | 1,255 |
| 1934 | 7.1 | 5.4 | 12.5 | 128.6 | 1,543 |
| 1935 | 9.5 | 11.3 | 20.8 | 153.7 | 1,844 |
| 1936 | 15.2 | 18.5 | 33.7 | 222.9 | 2,675 |
| 1937 | 17.0 | 19.6 | 36.6 | 242.8 | 2,914 |
| 1938 | 15.5 | 20.0 | 35.5 | 266.4 | 3,197 |
| 1939 | 14.9 | 27.7 | 42.6 | 295.9 | 3,551 |
| 1940 | 22.3 | 35.0 | 57.3 | 333.7 | 4,004 |
| 1941 | 36.7 | 41.9 | 78.6 | 500.6 | 6,007 |
| 1942 | 70.6 | 37.5 | 108.1 | 687.9 | 8,254 |
| 1943 | 20.4 | 16.7 | 47.1 | 272.8 | 3,274 |
| 1944 | 13.0 | 6.2 | 19.2 | 166.2 | 1,994 |
| 1945 | 23.8 | 9.3 | 33.1 | 274.9 | 3,299 |
| 1946 | 36.0 | 43.0 | 79.0 | 624.1 | 7,489 |
| 1947 | 29.1 | 39.9 | 69.0 | 646.7 | 7,760 |
| 1948 | 32.1 | 38.7 | 70.8 | 785.8 | 9,430 |
| 1949 | 28.6 | 43.4 | 72.0 | 863.3 | 10,360 |
| 1950 | 40.3 | 69.0 | 109.3 | 1,208.4 | 14,501 |

## BUILDING

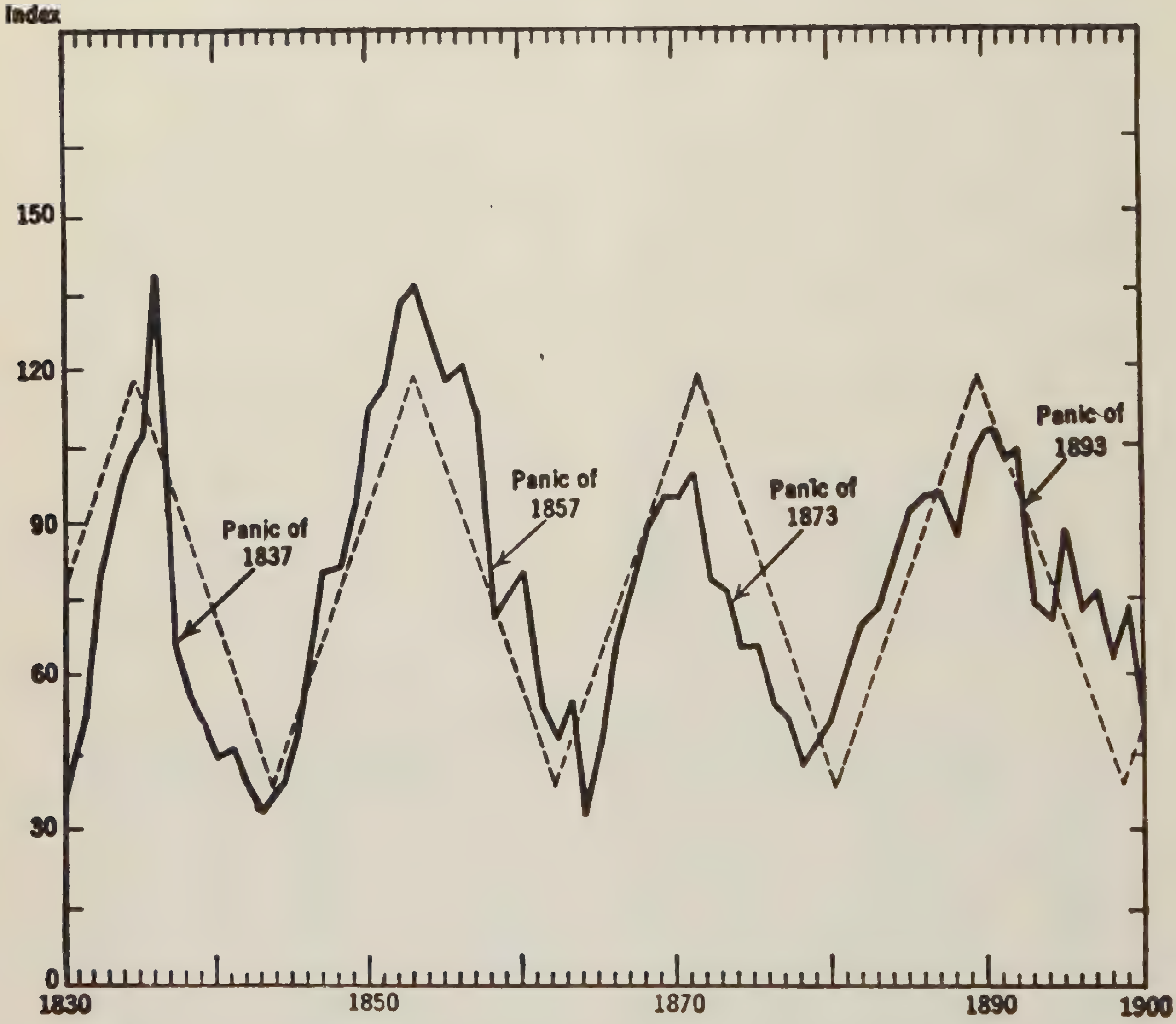


Fig. 1. The 18 1/3 year rhythm in building activity, 1830 - 1950. Solid line, 1830 - 1936, Warren & Pearson's Composite Index, adjusted for trend. Broken line, 1925 - 1950, area of construction contracts awarded in 37 states, by F. W. Dodge Corporation. Dashed line gives ideal 18 1/3 year cycle projected to show future tendencies if the cycle continues. Note drastic distortion during and after World War II.

# CONSTRUCTION

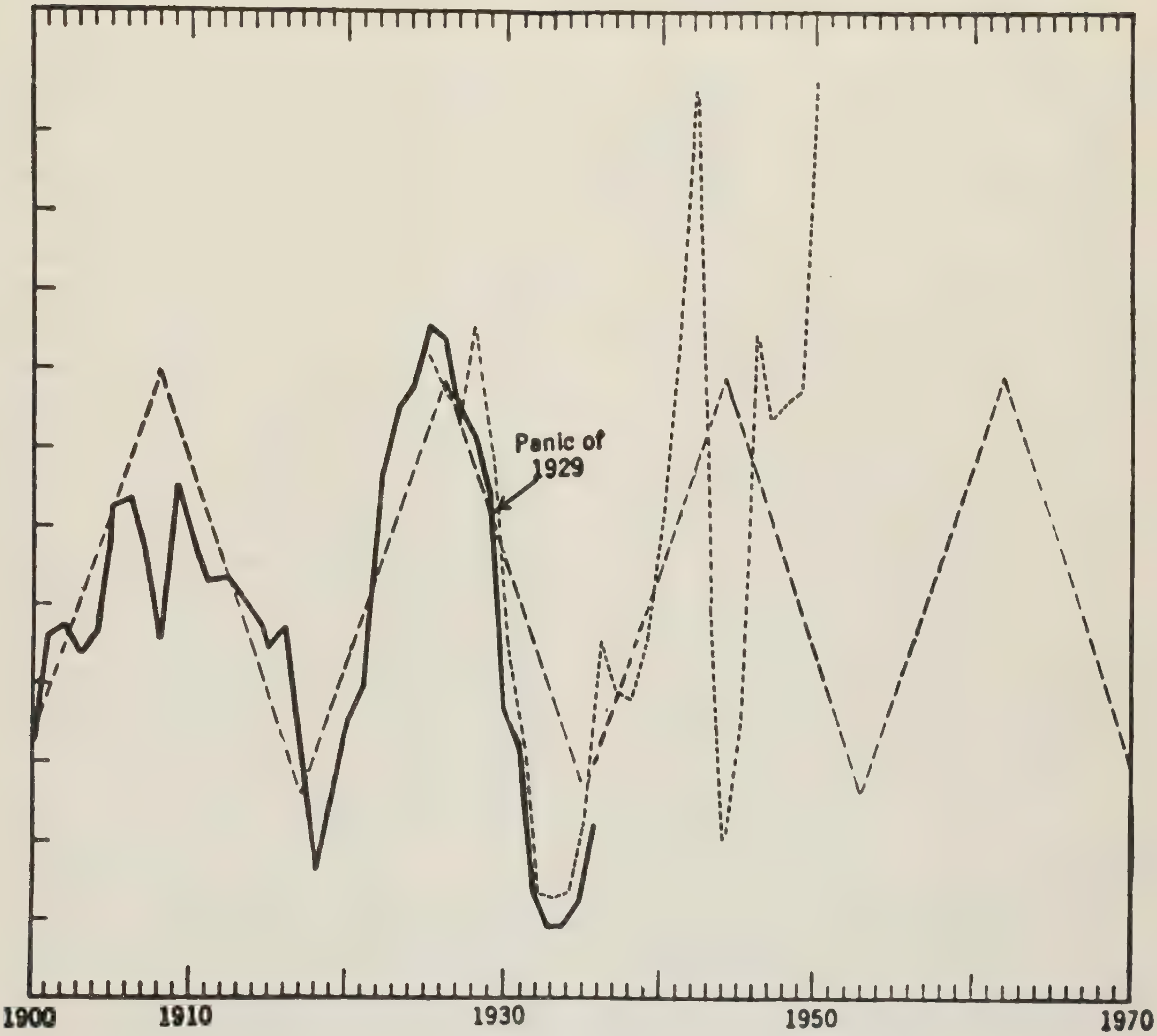


Fig. 1. Continued

# Ancient Cycles

## THE METONIC CYCLE

EVERY nineteen years the new moon falls on the same day of the calendar year. This “coming around again to the place of beginning” is called the Metonic cycle. It is named after a Greek named Meton who lived in Athens about 432 B.C. and who called attention to the coincidence.

The other day I had a letter from a man in China who had discovered this same fact. He was quite correct, but Meton beat him to the discovery by more than 2300 years. You cannot get ahead of the Greeks, can you?

The Metonic cycle was important in the old days because certain festivals were held according to the lunar months and certain other festivals were held according to the calendar months.

You have the same situation today with some of the church festivals such as Easter. You also have the situation in economic life if your company pays you on a 13-month calendar basis and the landlord and the public utility companies bill you on a 12-month calendar basis.

Of course our situation is fairly simple because every 13 pay days and every 12 bill paying days the two systems coincide again. But with the Greeks, until Meton, it was quite confused and things never seemed to get together, for the calendar year is 365 days, 5 hours, 48 minutes, and 46 seconds long, and 12 lunar months are only 354 days, 8 hours, 48 minutes, and 33.6 seconds long.

However Meton noticed that 235 lunar months seemed to be exactly equal to 19 years or 228 calendar months. (They are not quite equal but Meton was in error by only about 30 minutes a year.) On the basis of his observations Meton built a calendar in which the two systems of lunar and calendar months became reconciled.

Meton’s calendar involved a cycle of 19 years in which 12 years with 12 lunar months of 29 or 30 days each were interspersed with 7 years of 13 lunar months, in the following order: nineteen years of 12, 12, 13, 12, 12, 13, 12, 13, 12, 12, 13, 12, 12, 13, 12, 12, 13, 12, and 13 months respectively, and repeat.

## THE CALLIPPIC CYCLE

Meton did not have the instruments that we have today and of course did not know the length of the year with the exactness which is a commonplace to us. His cycle of 19 years of 355, or 354, or 384 days each added up to 6940 days, which is just a hair too long.

In about 100 years the discrepancy began to be apparent and Meton’s cycle was revised by Callipus into a “Great Year” of 76 calendar years made up of four 19-year Metonic cycles less one day.

The Callippic cycle was inaugurated in 330 B.C. on June 29th.

Of course Callipus’ calculations were not quite right either, but he was closer to the truth than Meton, and quite good enough for a good many years.

As 235 lunar months constitute a total of 6939.60249 days and as 19 years or 228 calendar months constitute a total of 6939.68835 days, you can easily figure Callippus’ error. He supposed 27,759 days to be the same as either 940 lunations or 76 years, whereas actually 940 lunations would take 27,758.4100 days and 76 solar years would take 27,758.7534 days. As this error would put his calendar out of step with the sun by only about one day every 300 years the old boy was not too far off at that. I wish we could do as well with some of our biologic and economic cycles.

# Technical

## LIMITATIONS OF THE PERIODOGRAM

PERIODIC tables, and periodograms based upon such tables, are useful tools to give you hints of cycles that may be present in a series of figures, but they are subject to severe limitations, as I have often pointed out.

(A **periodic table** is an arrangement of the data into columns and rows,—as many columns as there are terms in the cycle being investigated, and as many rows as there are cycles in the data. Thus, if you had a series of 12 figures and were studying 3-year waves, your periodic table would contain these 12 figures in four rows of three columns each.

(A periodogram is a chart on which you record the amplitudes of sine (or other) waves fitted to the averages of all the columns of various periodic tables, one wave being fitted to the averages from each table.)

One limitation of the periodic table and the periodogram is that the indicated cycle may not be present at all as a rhythmic or repetitive cycle. It may be merely a mathematical average. (See our October 1950 report, page 24; our November 1950 report, pages 20-26; our March 1951 report, page 94; and our April 1951 report, pages 140 and 141.

Another limitation is that even if the cycle is rhythmic and repetitive, the periodogram may not tell you the true length of the cycle. This fact may come as news to some students of cycles, although a moment's reflection should indicate that the statement is necessarily true.

Mr. W. C. Yeatman of Los Angeles has worked out two very pretty examples to show this latter limitation of the periodogram. With his permission his work is reproduced herewith.

### An example

For his first example, Mr. Yeatman added together two perfectly regular series of sine waves. In one series the waves were 40 months long, in the other series the waves were 42 months long. The addition was made over the full synodic period of 840 months, and the sum of these two waves is shown in Fig. 1.

(The synodic period is the period of time required for the two series of waves to come back into identical phase or positional relationship with each other. In this instance the synodic period is $\frac{40 \times 42}{2}$ months, or 840 months.)

If you were to make a 40-month periodic table of the sum of these two waves, using all 840 months, the average of each of the 40 columns of this table would have shown you the 40-month cycle, completely free and clear of the influence of the 42-month waves.

Similarly, if you were to make a 42-month periodic table of the combined waves, the average of the various columns would have shown you the 42-month cycle free and clear of the influence of the 40-month waves.

That is to say, **using the full synodic period**, the periodogram recording the amplitudes of the waves revealed by a succession of periodic tables would have indicated 40 and 42 months as the length of the waves. Moreover, the averages of the columns of the 40- and 42-month periodic tables would have revealed to you the amplitude, shape, and phase position of each of these two cycles correctly without any distortion whatever. This is true because, by construction, there are no other cycles in the series, and no accidental variations.

But suppose 840 months of data were not available? Or suppose, working blindly, you had not known in advance that the series contained both 40- and 42-month cycles? Suppose, for example, you had used the 480 months (40 years) of data from A to B. By inspection you would probably have suspected a cycle or cycles in the general neighborhood of 40 months. Suppose you had then constructed periodic tables of 37 months, 38 months, 39 months, 40 months, 41 months, 42 months, 43 months, 44 months, and 45 months.

The amplitude of the average wave revealed by each of these periodic tables is shown in the periodogram illustrated in Fig. 2. The periodogram shows two peaks, one at 39 months, the other at 44 months. Because these are the months showing greatest amplitude, some students of cycles might have accepted 39 months and 44 months as the indicated lengths of the two waves present concurrently in these figures.

Other students of cycles would have endeavored to introduce a refinement into the periodogram and would have continued the line connecting the point for 37 months with the point for 38 months until it met the continuation of the line connecting the point for 40 months with the point for 39 months. Such students would have used 38½ months as the length indicated by the periodogram. Such students would also have continued the line connecting the point for 42 months with the point for 43 months until it met the continuation of the line connecting the point for 45 months with the point for 44 months and would have placed the other peak at 43.4 months.

Nobody, I think, from the periodogram alone, would have suspected that the true lengths of the perfectly regular constituent waves were 40 and 42 months, respectively.

The periodogram would have been correct in indicating the possibility of two regularly recurring cycles in these series of figures, but it would have been completely erroneous in indicating 38½ months (or 39 months) and 43.4 months (or 44 months) as the proper length of these cycles.

### Another example

Suppose you now consider another example worked out by Mr. Yeatman. Fig. 3 shows the sum of three perfectly regular series of sine waves, 15 months, 18 months, and

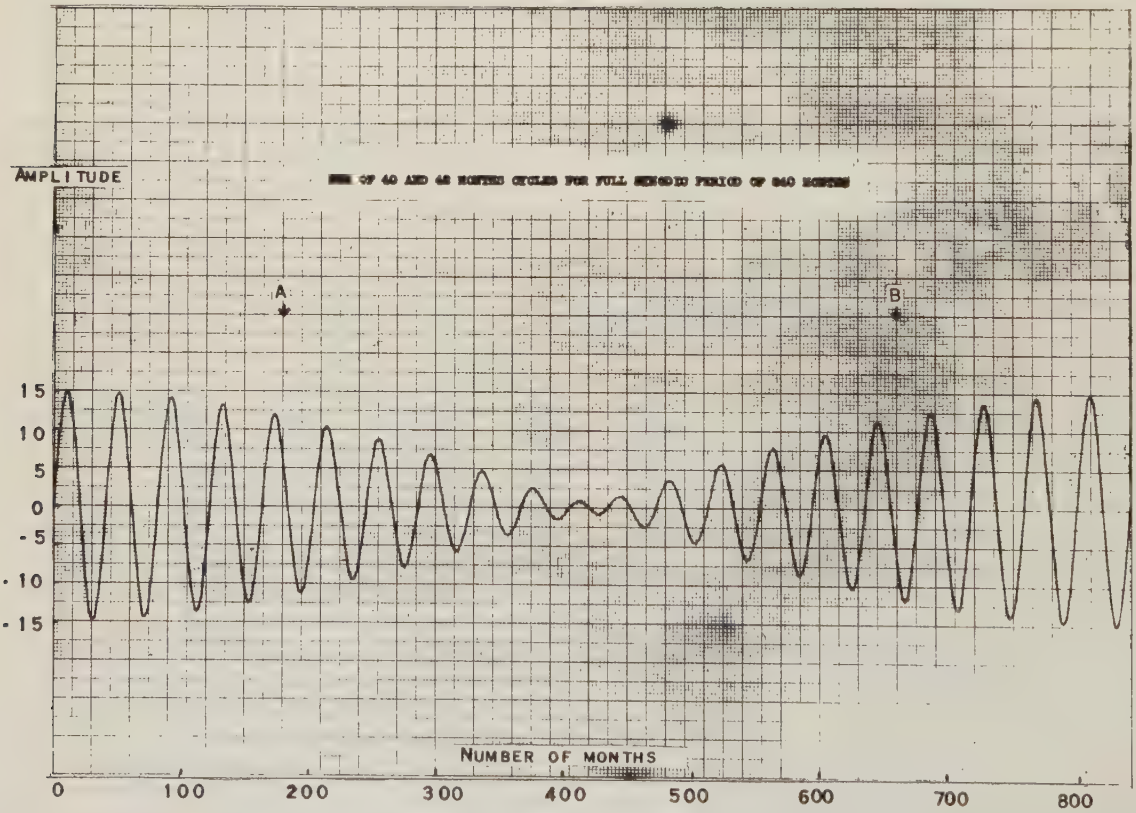


FIG. 1. SYNTHESIS (SUM) OF 40 AND 42 MONTH CYCLES (SINE SHAPE) FOR FULL SYNODIC PERIOD OF 840 MONTHS.

20 months long respectively, added together for their full synodic period of 180 months.

Here again, if you had used the full 180 months of data, your periodogram would have revealed correctly, the 15-, 18-, and 20-month cycles. The averages of your periodic tables of these lengths would have shown you each of the three waves correct for amplitude, phase, and shape, completely freed from the distorting effects of the other two waves.

However, in his experiment, Mr. Yeatman limited himself to 145 months of his data and obtained the periodogram shown in Fig. 5. This periodogram shows amplitudes for average waves of 12, 13, 14, 14½, 15, 15½ 16, 16½, 17, 17½, 18, 18½, 19, 19½, 20, 20½, 21, and 22 months in length, respectively.

This periodogram correctly indicates the concurrent presence of three cycles in this series of figures, but, as in the other example, it completely misleads you in regard to their wave lengths. The periodogram charted in Fig. 5 shows peaks at 15.35, 17.6, 20.5 months, whereas, as you know, the true lengths are 15, 18, and 20 months.

How sadly wrong anyone would have been who, accepting at their face value the results indicated by the periodogram, had assumed that the series contained waves of 15.35, 17.6, and 20.5 months and had made predictions based upon this erroneous assumption!

The periodogram is a useful tool to give you **hints** of the existence of regularly recurring cycles in a series of figures, but you must use this information merely as a starting point.

Then you must go further to discover whether or not the indicated cycle or cycles are really rhythmic and repetitive and can therefore be expected to continue.

Finally you must go still further and discover whether or not the length indicated by the periodogram is the true length If it is not the true length you must find the true length before your analysis will have any practical forecasting value whatsoever.

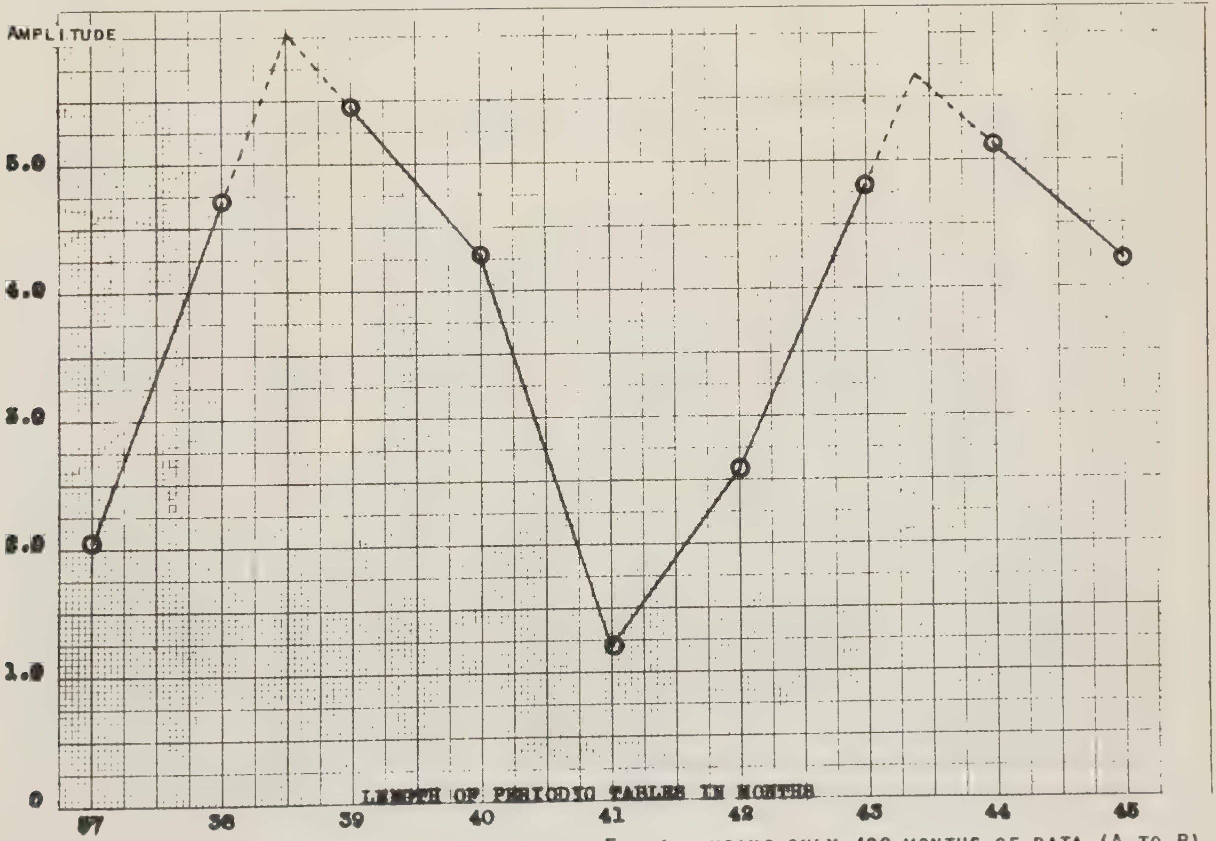


FIG. 2. PERIODOGRAM OF THE SYNTHESIS SHOWN IN FIG. 1., USING ONLY 480 MONTHS OF DATA (A TO B). SHOWING RESULTS FOR WAVE LENGTHS 37 MONTHS TO 45 MONTHS INCLUSIVE.

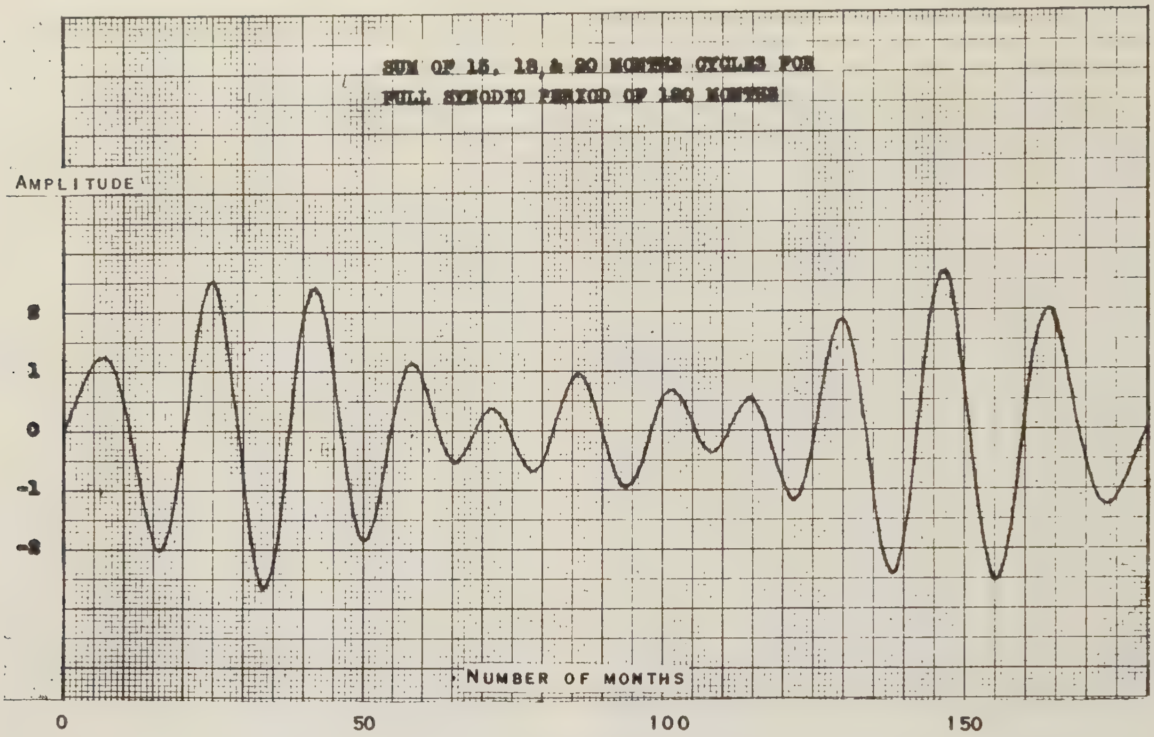


FIG. 3. SYNTHESIS (SUM) OF 15, 18, & 20 MONTH CYCLES (SINE SHAPE) FOR FULL SYNODIC PERIOD OF 180 MONTHS.

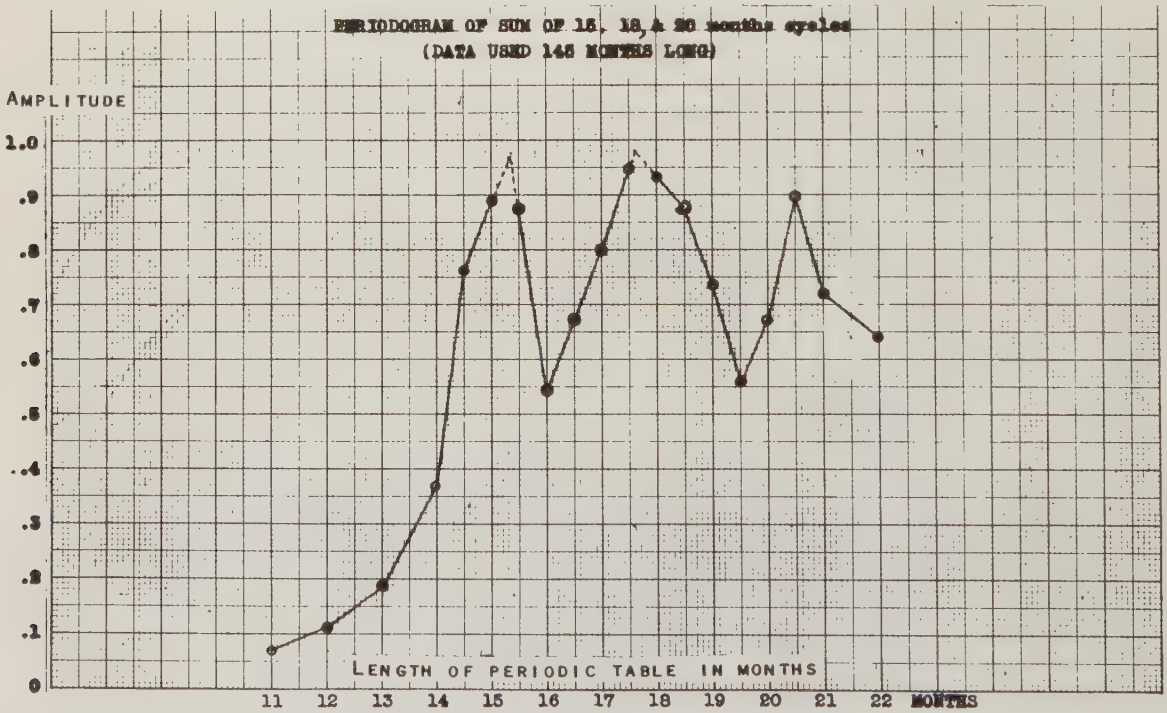


FIG. 5. PERIODOGRAM OF THE SYNTHESIS SHOWN IN FIG.3., USING ONLY 145 MONTHS OF DATA, WAVE LENGTHS 11 TO 22 MONTHS INCLUSIVE.

# TECHNIQUES INVOLVED IN THE DETERMINATION OF THE 9.2-YEAR CYCLE IN INDUSTRIAL COMMON STOCK PRICES

DATA used were quarterly averages of the logs of the Cowles Commission--Standard and Poor's Corporation Index of industrial common stock prices adjusted for trend, January 1871 through December 1950, as printed in our April report on pages 146 and 147. These quarterly averages are charted in Curve A of Fig. 1 on pages 206 and 207 of this issue.

To provide a slightly longer series of figures, the quarterly averages of the Clement-Burgess index of railroad stock prices, January 1854 through December 1870, adjusted for trend, and raised to tie into the Cowles Commission Index, were also included in the analysis to a limited extent.

Trend of the Clement-Burgess index was considered to be a straight line fitted by means of least squares to the logs of annual values 1854—1883. Deviations from this trend, of course in logs, were raised by .031 to equalize the values of the two series of deviations for the year 1871.

To minimize the effects of the minor waves a 13-quarter-year moving average of these values was computed. This moving average is plotted as Curve B in Fig. 1 on pages above mentioned.

Nine-year time charts were then constructed of each of the two above-mentioned series, namely, the raw data adjusted for trend and the 13-quarter-year smoothing of these raw data. The time charts indicated a wave slightly longer than 9 years.

To obtain the length of this wave as accurately as possible, a 9¼-year (37-quarter-year) periodic table of the 13-quarter-year moving averages of the strictly industrial data (1871-1950) was then constructed. The first and second halves of this table, minus one high and one low in each column of each half, were then computed. The typical waves of these two halves of the periodic table of the smoothed deviations did not fall exactly under each other; the typical wave for the second half of the series slipped 1/4 of a year to the left. This slippage of 1/4 year in four cycles or 1/16 year per cycle thus indicated the true length of the cycle to be more nearly 9.1875 years in length. As such accuracy is specious when one is considering as few as 10 waves, the length was rounded to 9.2 years.

As a check, a 9.2-year periodic table of the unsmoothed quarterly averages was then constructed. Each pair of cycles was then averaged. This process gave us typical 9.2-year cycles largely free from the distorting effect of any 17-, 18-, or 19-year waves that might be present and also of any waves in the general neighborhood of 6 years that might distort the picture. The 9.2-year wave, in roughly the same amplitude and timing, was present consistently throughout the series.

The pair of cycles derived from the Clement-Burgess index was found to correspond closely for amplitude and timing with the other pairs of cycles. Therefore we felt justified in using the Clement-Burgess figures in the determination of average shape and amplitude of the 9.2-year wave.

Being as sure of the length of this cycle as we could be, prior to a complete removal of all other waves, we obtained the average shape and amplitude of the wave by averaging the entire 9.2-year periodic table, exclusive of one high and one low in each column. The resultant wave was clearly zigzag in shape.

To obtain the timing and the amplitude of the highs and lows as accurately as possible, this average wave was also smoothed by means of a 12-quarter-year moving average. The smoothed curve proved to be symmetrical, both around the axis and with respect to highs and lows.

As a 12-quarter-year moving average removes a third of the amplitude of the zigzag wave, the amplitude of the ideal wave was reconstructed from the moving average. It was found to have an amplitude, in logs, of .091. The constructed ideal wave, fitted to the actual average medians of the periodic table, showed close correspondence.

This ideal wave was then added to both curves in Fig. 1 on pages 206 and 207 and projected into the future to show average future behavior, if the cycle continues unchanged.

# Construction of the Charles H. Pinkham Index of Advertising Efficiency

In the article about the 22-year cycle in the Index of Advertising Efficiency of the Lydia E. Pinkham Medicine Company I told you that I would tell you how this index was prepared.

Let me say at the beginning that the method was developed by Mr. Charles H. Pinkham, Research Director of the company, and advertising consultant, of Intervale, New Hampshire. I shall try to describe the method accurately enough so that you can apply it to your own figures. The results obtained by Mr. Pinkham definitely justify your investigation of the method.

To start with, Mr. Pinkham computed two series of percentages. One series consisted of the percentages that the sales for each year were of the sales of the year before. In other words, a simple one-year moving percentage of sales. The other series consisted of the percentages that the advertising expenditures for each year were of the sales for the year before.

He then made a scatter diagram with advertising as a percentage of last year's sales as the independent variable (X-axis) and sales as a percentage of last year's sales as the dependent variable (Y-axis).

If you do not know how to make a scatter diagram, refer to any text book of statistics. (In Croxton and Cowden's **Applied General Statistics** the process is described on pages 651 and 652.)

Having made his scatter diagram, Mr. Pinkham fitted a straight line to the various points by the method of least squares (also explained in any text book of statistics) and thus obtained a new series of points which gave him " normal " sales for any given advertising percentage.

As he knew the percentage which the advertising for each year really was of the sales of the year before, Mr. Pinkham knew the percentage which the sales for that year " ought " to be of the sales for the year before. The percentage by which the actual sales percentage was above or below the ideal sales percentage represents what Mr. Pinkham calls the Index of Advertising Efficiency.

For example, in 1888 the company spent for advertising a sum of money equal to 13% of 1887 sales. According to the normal determined from the scatter diagram, one might expect with this amount of advertising that 1888 sales would be 71% of 1887 sales. Actually 1888 sales were only 47% of 1887 sales, so it is clear that something prevented the advertising from doing a " normal "job. This something is measured by finding the percentage by which the actual sales percentages in comparison with the previous year are above or below normal. In this instance the arithmetic would be as follows:

$$-\frac{71-47}{71} = -\frac{24}{71} = -34\%$$

Next year, in 1889, the advertising amounted to 15% of 1888 sales. Fifteen percent advertising should result in 73% sales, but actually the sales for 1889 were 85% of 1888 sales. Something helped advertising along. This something is measured just as for 1888, namely,

$$+\frac{85-73}{73} = \frac{12}{73} = +16\%$$

In my chart of these figures shown on page 223 of this report, I added 97 to each figure obtained by Mr. Pinkham to change to an index number basis and to more nearly equalize the values around 100 as an axis. Thus the figure for 1888 becomes -34+97 or 63, the second figure becomes 16+97 or 113, and so on.

In closing I might mention that the original sales figures do not show, at least by inspection, any evidence of cycles. It takes the above manipulation to bring out the 22-year cycle so that its presence can be known and suitable action taken to offset its effects.

# Data

## PRICES 1933-1950 IN TERMS OF GOLD

STUDENTS of price cycles are confronted with a perplexing complication because our government in 1933 abolished free and unrestricted convertibility of currency into gold and later, in 1934, devalued our currency in terms of gold.

Of course we had been on a greenback basis before, from February 25, 1862 to January 1, 1879, but most long-term price series with which you come in contact have probably been adjusted to a gold basis for this relatively brief period of time.

I think it is fair to assume that any cycles discovered in figures from 1795 to 1932 (adjusted to gold when needed) are cycles of prices in terms of gold, and that any predictions based upon a knowledge of such cycles are predictions in terms of gold prices.

But the prices we read in the newspapers are not gold prices--they are prices in terms of "funny money"--prices in terms of inconvertible greenbacks.

How can we get on a "gold basis" for purposes of statistical homogeneity? That is, how can we convert our funny-money prices into prices as they would have been if we were still on the 1932 gold standard?

Probably there is no way in which this conversion can be made accurately, but one way of approaching the problem would be to divide the annual series you wish to convert by 1/20th of the corresponding New York City black market price of United

TABLE 2

| YEAR | A<br>INDEX OF AVERAGE WHOLESALE PRICES, ALL COMMODITIES, IN PAPER DOLLARS | B<br>OPEN MARKET OR BLACK MARKET PRICES OF 1/20 DOUBLE EAGLES IN U.S. PAPER DOLLARS | C<br>INDEX OF AVERAGE WHOLESALE PRICES, ALL COMMODITIES, IN GOLD (1926-32), OR IN BLACK MARKET GOLD (1933-1950) (COL. A ÷ COL. B) |
|---|---|---|---|
| 1926 | 100.0 | $1.00 | 100.0 |
| 1927 | 95.4 | 1.00 | 95.4 |
| 1928 | 96.7 | 1.00 | 96.7 |
| 1929 | 95.3 | 1.00 | 95.3 |
| 1930 | 86.4 | 1.00 | 86.4 |
| 1931 | 73.0 | 1.00 | 73.0 |
| 1932 | 64.8 | 1.00 | 64.8 |
| 1933 | 65.9 | 1.31 | 50.5 |
| 1934 | 74.9 | 1.80 | 41.6 |
| 1935 | 80.0 | 1.74 | 46.0 |
| 1936 | 80.8 | 1.72 | 41.9 |
| 1937 | 86.3 | 1.73 | 50.0 |
| 1938 | 78.6 | 1.79 | 43.5 |
| 1939 | 77.1 | 1.81 | 42.7 |
| 1940 | 78.6 | 1.86 | 42.4 |
| 1941 | 87.3 | 1.73 | 50.4 |
| 1942 | 98.8 | 1.81 | 54.5 |
| 1943 | 103.1 | 1.81 | 57.1 |
| 1944 | 104.0 | 1.91 | 54.4 |
| 1945 | 105.8 | 2.03 | 52.1 |
| 1946 | 121.1 | 2.08 | 58.1 |
| 1947 | 152.1 | 2.16 | 70.3 |
| 1948 | 165.0 | 2.28 | 72.4 |
| 1949 | 155.0 | 2.24 | 69.3 |
| 1950 | 161.7 | 2.06 | 78.6 |

States double eagles ($20.00 gold pieces).

I am fortunate in being able to give you these black market prices through the very great courtesy of PICK'S WORLD CURRENCY REPORT, 75 West Street, New York City, a research organization specializing in statistical information on black, gray, and white market prices of currency and precious metals.

The prices are shown in Table 1.

Suppose, for an example, you apply this procedure to average wholesale prices for all commodities, as compiled by the Bureau of Labor Statistics in Washington. If you do this you will get the results shown in Table 2.

In Fig. 1 I have plotted for you the index in terms of black market gold as well as the index expressed in the usual way in funny-money inconvertible paper dollars.

Do not be misled into thinking that

TABLE 1.

| YEAR | BLACK MARKET PRICE OF DOUBLE EAGLES IN U.S. PAPER DOLLARS, NEW YORK | PRICE OF DOUBLE EAGLES IN PAPER DOLLARS, DIVIDED BY TWENTY |
|---|---|---|
| 1932 | $20.00 | $1.00 |
| 1933 | $26.10 | 1.31 |
| 1934 | 35.95 | 1.80 |
| 1935 | 34.73 | 1.74 |
| 1936 | 34.44 | 1.72 |
| 1937 | 34.54 | 1.73 |
| 1938 | 35.85 | 1.79 |
| 1939 | 36.13 | 1.81 |
| 1940 | 37.10 | 1.86 |
| 1941 | 34.69 | 1.73 |
| 1942 | 36.23 | 1.81 |
| 1943 | 36.10 | 1.81 |
| 1944 | 38.27 | 1.91 |
| 1945 | 40.65 | 2.03 |
| 1946 | 41.69 | 2.08 |
| 1947 | 43.27 | 2.16 |
| 1948 | 45.58 | 2.28 |
| 1949 | 44.75 | 2.24 |
| 1950 | 41.17 | 2.06 |

WHOLESALE PRICES

ALL COMMODITIES

YEARLY AVERAGE

1926=100

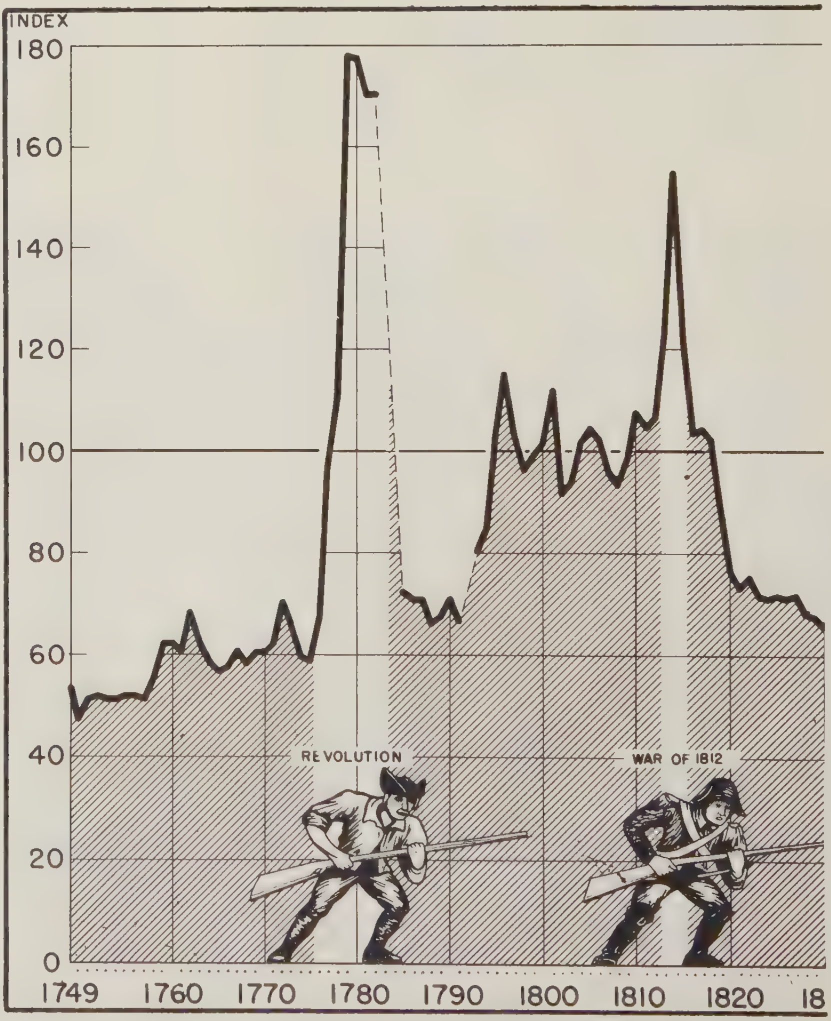


FIG. 1. AVERAGE WHOLESALE PRICES, ALL COMMODITIES, 1749 - 1950 (B.L.S.), TOGETHER WITH THE SAME PRICES IN GOLD AT BLACK MARKET RATES IN N. Y. CITY FOR DOUBLE EAGLES (PICK'S WORLD CURRENCY REPORT), 1932 - 1950.

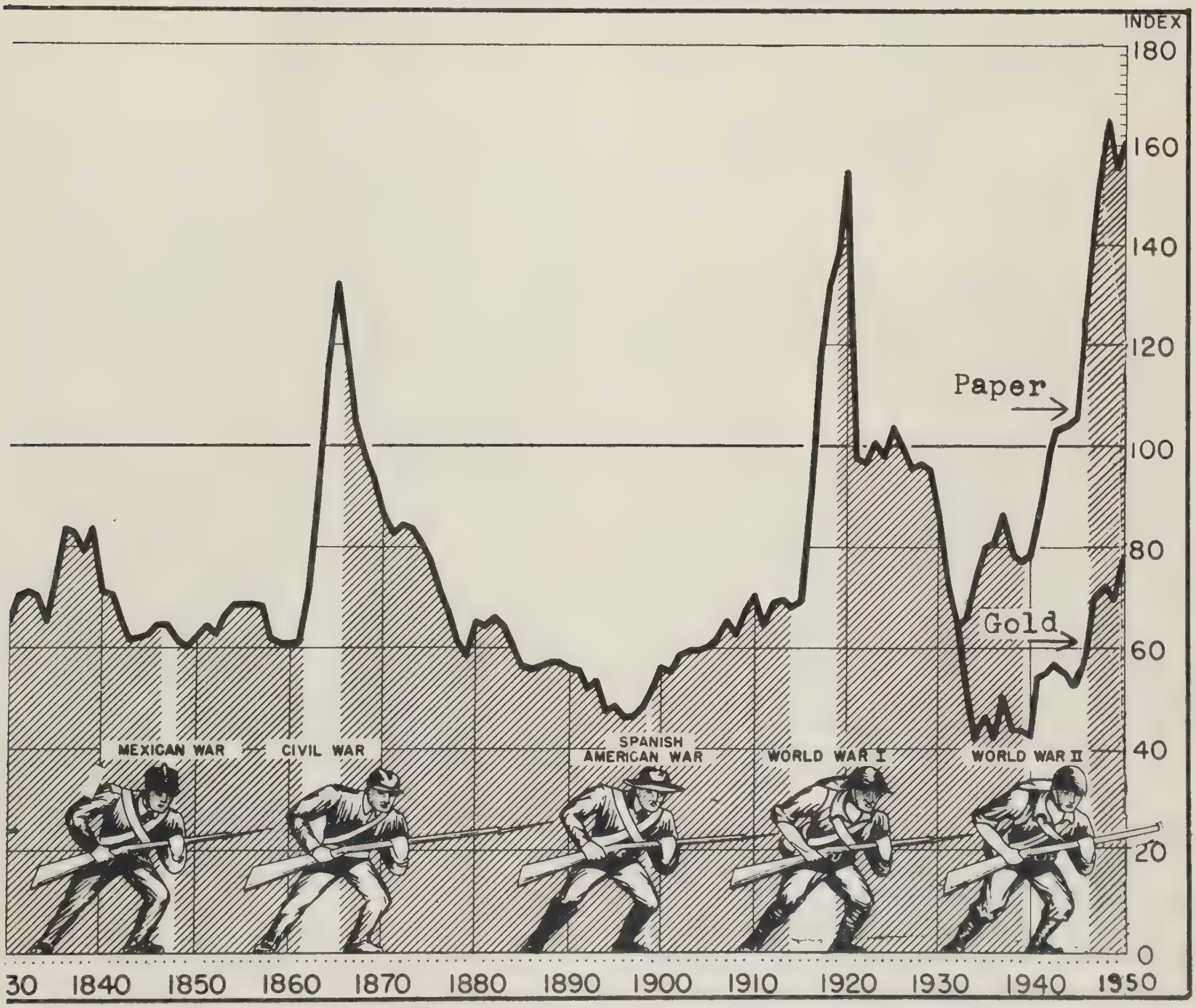
these average wholesale prices expressed in terms of black market gold are identical with the average wholesale prices in dollars as they would have been if we had never left the gold standard. As I said at the beginning, there is no way that I know of of making an exact determination of what these latter prices would have been. But I trust that as cycle students you will be helped by the expedient I have used to gain a truer knowledge of how the cycles are unfolding, and that these figures will also help you to make more exact determinations of the various cycles present in the commodity prices in which you are interested.

For example, when one looks at the average wholesale price curve converted to a gold basis one sees at once some preliminary evidence of a cycle of about 22 years in length with a low about 1940. Such a cycle would probably not appear from casual observation of the curve with prices from 1932 expressed in paper money, nor, in my opinion, could the exact characteristics of this cycle be as well determined from the paper money curve.

Similarly the price distortion of World War II and Post World War II appears in much more realistic proportions in the curve adjusted to a gold basis.

Every seller should, in my opinion, convert his present prices to a gold basis to see if, in terms of gold, his prices are above or below what they used to be. If this were done there would be some surprising revelations.

Table 1 provides a basis by which this conversion can be made. The next step is up to you! Many a company has **cut** its prices in terms of gold and is suffering from the pangs of financial malnutrition as a result. See to it that your company is not in this category.



# Letters

Dear Dr. Dewey:

Since you intend to republish my article on Nelson's work I think it advisable to modify a passage which occurs in the introduction and which states that during periods of sunspot activity electrical communication by radio or cable may be interrupted but that nothing much can be done about cable communication at such times. The cable companies admit that sunspot activity did affect cable communication in former years but that East-West cables are now operated in such a manner that all low frequency disturbances such as those caused by sunspots have little effect whatsoever on the transmission or reception of signals. The disturbances occur to a lesser degree in the North-South direction, for which reason nothing is done about them.

Sincerely yours,
Waldemar Kaempffert
Science Editor

The New York Times
New York, N.Y.

Dear Mr. Dewey:-

I came across my letter of April 4th recently and it occurred to me that I had not been properly grateful for the recent magazine which you sent me showing the Cycles of War.

I have been saying to my friends who thought that war was imminent that I was a member of the Foundation for the Study of Cycles and that the cycles did not show war to be particularly imminent. In fact, that it might be ten years off. As a result of this I have quit worrying about the imminence of war and while of course it may be just around the corner, I am not going to bother about it at the present time and go about my business.

Yours very sincerely,
Dean B. Gregg

Dear Mr. Gregg:

Thank you so much for the kind words you say about our February issue.

It is quite true that there are quite a number of years before the big 22-year cycle in the number of international battles is due for its next peak.

It is also true that it will be several years before the next peak of the important 11-year cycle in the number of international battles is due for its peak.

From the standpoint of these two cycles therefore, international battles should be relatively few for the next several years.

On the other hand, there is a short 3.4-year cycle in the number of international battles--or at least there has been since 1900--and this cycle is now on the upswing and due for its crest (maximum number of battles) the latter part of this year.

I think the cycles in war are very important to know about, but I don't want your knowledge of them to lull you into any false sense of security.

First, there have been many exceptions to the cycles in the past and there doubtless will be in the future.

Second, although the 22-year cycle has been very regular since 1800, there were times between 1400 and 1800 when we had three cycles in 44 years instead of the standard two cycles, and there have been other variations. If something like this should happen again it would advance the date of the crest of the next cycle considerably.

Third, there is nothing to prevent the arbitrary starting of a cycle by someone who knows about cycles and wants to beat the gun.

Fourth, cycles sometimes come true in unexpected ways. For example, suppose that all our cities were laid waste tomorrow morning. Might not it be 8 or 10 years before we could recover sufficiently to engage in the maximum number of land battles on the fighting fields of Europe and Asia? Even if the cycles do work out for maximum number of battles in the late 1950's or early 1960's, that fact might conceivably have very little to do with the date of the actual starting of the war.

Very cordially yours,
Edward R. Dewey

# Foundation Reprints

*(Semi-popular material believed to be of general interest)*
Reprints are available to the general public at $1 each.

No. 1. CYCLES, reprinted from *American Mammals*, by W. J. Hamilton, Jr., published by McGraw-Hill Company, New York, 1939. Format 5½"x8½". 18 pages, 3 charts, one illustration and a bibliography. Issued 1943. (Now out of print.)

No. 2. CYCLES: LYNX AND FISH, MICE AND MEN—AND DOLLARS. An editorial, and CYCLES AS AN AID TO POST WAR PLANNING by the Director, reprinted from *General Electric Review* of May 1943, Volume 46, Number 5, (largely a condensation of Putting Cycles to Work in Science and Industry.) Format 8½" x 11", 10 pages, with 5 charts. Issued 1944. (Now out of print.)

No. 3. EMOTIONAL CYCLES IN MAN, By Rex B. Hersey, Reprinted from the *Journal of Mental Science*. January 1931. Format 5½" x 8½", 22 pages. Issued 1944. Reissued 1946.

No. 4. CYCLES, reprinted from *The Causes of Economic Fluctuations* by Willford I. King, published by the Ronald Press Company, New York, 1938. Format 5½" x 8½", 26 pages, with 4 charts and a bibliography. Issued 1944. (Now out of print.)

No. 5. THE PREDICTION OF TIDES by Captain Paul C. Whitney, reprinted from the *United States Naval Institute Proceedings*, Volume 66, Number 12, Whole Number 454, December, 1940. Format 5½" x 8½", 8 pages with 2 charts. Issued 1944.

No. 6. MATAMEK CONFERENCE ON BIOLOGICAL CYCLES. A report by Ellsworth Huntington. Published 1932. Format 5½" x 8½", 16 pages with 1 chart. Issued 1944.

No. 7. CYCLES IN HISTORY, reprinted from *Today and Destiny* by Edwin Franden Dakin, published by Alfred A. Knopf, New York, 1940. Format 5½" x 8½", 22 pages. Issued 1944. Reissued 1948.

No. 8. THE LONG WAVES IN ECONOMIC LIFE, by N. D. Kondratieff, reprinted from *The Review of Economic Statistics*, Volume XVII, Number 6, November 1935. Format 8½" x 11", 14 pages with charts. Issued 1944. (Now out of print.)

No. 9. PERIODIC INSPIRATION IN POETRY AND MUSIC by J. H. Douglas Webster, reprinted from *The Poetry Review* (London), Volume XXXIV, Number 3. Format 5½" x 8½", 4 pages. Issued 1945.

No. 10. SOLAR AND ECONOMIC RELATIONSHIPS by Carlos Garcia-Mata and Felix Shaffner, reprinted from *The Quarterly Journal of Economics*, Volume XLIX, November 1934. Format 5½" x 8½", 51 pages with 12 charts. Issued 1945. Reissued 1949.

No. 11. PUTTING CYCLES TO WORK IN SCIENCE AND INDUSTRY—a popular lecture given by the Director before the McGill University chapter of Sigma Xi. This talk deals with rhythms in many fields, but chiefly with rhythms in business. Format 8½" x 11", 24 pages, with 21 charts and one illustration; published 1941. Reissued as a reprint in 1945.

No. 12. TESTING CYCLES FOR STATISTICAL SIGNIFICANCE. A technical bulletin applying the Bartels test of significance to a time series cycle analysis. By Charles E. Armstrong. Format 5½" x 8½", 13 pages with 5 tables and 1 chart. Issued 1945 (Now known as Technical Bulletin No. 2)

No. 13. DETECTION AND ISOLATION OF RHYTHMS—AN OUTLINE. Technical Bulletin by Edward R. Dewey. 5 pages, 1 table. Reissued 1945. (Now known as Technical Bulletin No. 1)

No. 14. CYCLES, RHYTHMS AND PERIODICITIES. Reprinted from *Mainspring of Civilization*, by Ellsworth Huntington, published by John Wiley & Sons, Inc., New York, 1945. Format 5½" x 8½", 24 pages, with 5 charts. Issued 1945. (Now out of print.)

No. 15. TWO INTRIGUING CYCLES. Reprinted from *Mainsprings of Civilization*, by Ellsworth Huntington, published by John Wiley & Sons, Inc., New York, 1945. 24 pages, 7 charts. Format 5½" x 8½". Issued 1946. (Now out of print.)

No. 16. BROADER ASPECTS OF ENVIRONMENTAL CYCLES. Reprinted from *Mainsprings of Civilization*, by Ellsworth Huntington, published by John Wiley & Sons, Inc., New York, 1945. 18 pages, 8 charts. Format 5½" x 8½". Issued 1946. (Now out of print.)

No. 17. THE SUN MAKES THE WEATHER—1. Measuring Solar Variation, by C. G. Abbot. Reprinted from *The Scientific Monthly*, March, 1946. Format 6¾" x 9¾", 10 pages, 10 illustrations. Issued 1946.

No. 18. THE SUN MAKES THE WEATHER—2. Weather Effects of Solar Variation, by C. G. Abbot. Reprinted from *The Scientific Monthly*, April, 1946. Format 6¾" x 9¾", 8 pages, 3 charts. Issued 1946.

No. 19. A REPRESENTATION OF THE SUNSPOT CYCLE, by C. N. Anderson. Reprinted from the *Bell System Technical Journal*, Vol. XVIII, pp. 292-299, April, 1939. Format 6¾" x 9¾". 8 pages, 4 charts. Issued 1947.

No. 20. A STATISTICAL STUDY OF THE RECORDS OF SALMON FISHING ON THE RESTIGOUCHE RIVER, by Earle B. Phelps, Professor, Sanitary Science, Columbia University, and David L. Belding, Professor, Pathalogy and Bacteriology, Boston University School of Medicine. Privately printed. Format 6¾" x 9¾", 37 pages, 8 charts. Issued 1947.

No. 21. FIELD MOUSE CYCLES (Life and Habits of Field Mice), by W. J. Hamilton, Jr. Reprinted from *The Scientific Monthly*, Vol. L., pp. 425-434, May, 1940. Format 6¾" x 9¾", 10 pages, 7 illustrations, 2 charts. Issued 1947.

No. 22. SUNSPOTS AND ABUNDANCE OF ANIMALS, by D. A. Maclulich. Reprinted from the *Journal of the Royal Astronomical Society of Canada*, July 1936. Format 6¾" x 9¾", 14 pages, 2 charts, 7 illustrations, bibliography. Issued 1947.

No. 23. TREE RINGS AND CLIMATE THROUGH THE CENTURIES, by W. A. Harwood. Reprinted from *Weather*, Vol. 11, No. 4, April 1947, pp. 112-120. Format 6¾" x 9¾", 13 pages, 7 illustrations. Issued 1947.

No. 24. BENNER'S PROPHECIES OF FUTURE UPS AND DOWNS IN PRICES, by Samuel Benner. A reprint of a book published in 1876. Format 6¾" x 9¾", 34 pages (reproducing all 131 pages of the original book), 4 charts. Issued 1948.

No. 25. THE SUN'S SHORT REGULAR VARIATION AND ITS LARGE EFFECT ON TERRESTRIAL TEMPERATURES, by C. G. Abbot. Reprinted from *Smithsonian Miscellaneous Collections*, Vol. CVII, Number 4, April 4, 1947. Format 6¾" x 9¾", 33 pages, 9 tables, 12 figures. Issued 1948.

No. 26. CYCLES IN SEDIMENTARY ROCK DEPOSITS, by Wilmot H. Bradley. Reprinted from Professional Paper 158-E, *The Varves and Climate of the Green River Epoch*, 1929. Format 6¾" x 9¾", 8 pages, foreword, 7 illustrations, 2 charts. Issued 1948.

No. 27. FLUCTUATIONS IN NUMBERS OF BIRDS IN THE TORONTO REGION, by J. Murray Speirs. Reprinted from *The Auk*, Volume 56, October 1939. Format 6¾" x 9¾", 13 pages, 7 illustrations, 2 charts, and bibliography. Issued 1948.

No. 28. RECURRING CYCLES OF FASHION. Reprinted from *Recurring Cycles of Fashion*, by Agnes Brooks Young, published by Harper & Brothers, New York and London, 1937. Format 6¾" x 9¾", 15 pages, 81 illustrations. Issued 1948.

No. 29. VARIABLE STARS. Reprinted from *Astronomy*, by William T. Skilling and Robert S. Richardson, published by Henry Holt & Company, Inc., New York, 1947. Format 6¾" x 9¾", 7 pages, 1 illustration, 4 charts. Issued 1949.

No. 30. RHYTHMS IN NATURE — DAILY, LUNAR, ANNUAL, AND SUNSPOT CYCLES, AND PERIODIC MIGRATION. Reprinted from *Animal Ecology*, by A. S. Pearse, published by McGraw-Hill Book Company, Inc., New York, 1939. Format 6¾" x 9¾", 25 pages, 3 maps. Issued 1949.

No. 31. SEASON OF BIRTH. Reprinted from *Season of Birth—Its Relation to Human Abilities*, by Ellsworth Huntington, published by John Wiley & Sons, Inc., New York and London, 1938. Format 6¾" x 9¾", 18 pages. Issued 1949.

No. 32. BIOLOGICAL RHYTHMS AND CYCLES, by Nathaniel Kleitman. Reprinted from *Physiological Reviews*, Vol. 29, No. 1, January, 1949. Format 6¾" x 9¾", 30 pages. Issued 1950.

# Why not join the Foundation?

If you want to keep informed in regard to developments in the field of cycles and wish to assist, your financial and moral support will be very much appreciated.

We rely entirely upon voluntary contributions.

All that is necessary is to send in your check with an indication of the class of membership you desire. $10 of your contribution will be applied toward a subscription to **Cycles--A Monthly Report** for one year.

☐ **Regular members** contribute from $10 to $249 a year, according to their interest and means. Regular members receive without additional cost, all monthly reports and all reprints as issued. They may buy technical bulletins and special reports at cost. When their contribution is $50 or more per year they may have consultation privileges in proportion to their contribution.

☐ **Associate members** contribute $250 or more a year, and are known as Associates of the Foundation. They receive without additional cost all material issued by the Foundation. In addition they have liberal consultation privileges.

☐ **Corporation members** contribute from $100 to $5,000 a year. Corporation members receive all material issued by the Foundation without charge. In addition, they may have consultation privileges in proportion to their contribution.

☐ **College members** contribute from $5.50 to $25 a year. They must be full-time students or faculty members of recognized colleges and/or universities. They receive the same benefits as **Regular Members**. (Please indicate college, and class, or faculty position.)

☐ **Scientific members** pay no dues, but get none of the publications. They have the privilege of buying publications at membership discount. Scientific membership is limited to persons who have published scientific papers in the field of cycles.

☐ **Library members**. A limited number of free public and college libraries who agree to index, display, and bind the publications of the Foundation are elected to library membership.

A member may be dropped at any time for failure to keep up his annual contribution, or for any other reason. A member may resign at any time without liability except for the payment of the agreed upon contribution to the date of resignation. Members agree not to use the fact of membership for advertising purposes.

Contributions are deductible for income tax purposes.

Make check payable to Foundation for the Study of Cycles. Mail to Publication Office at
9 East 77th Street, New York 21, N.Y.